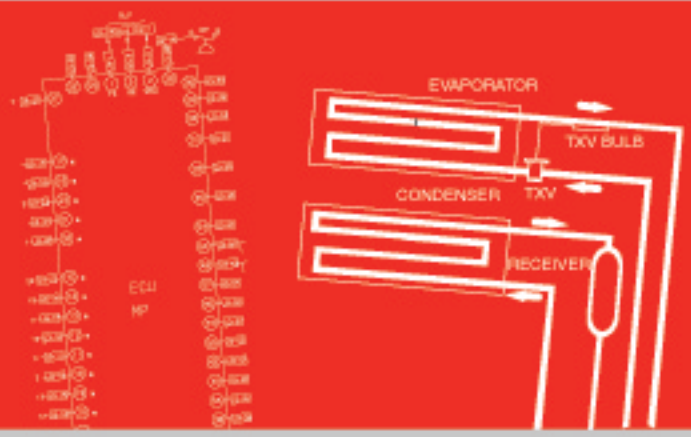
Carrier

Trailer Refrigeration



OPERATION & SERVICE

for

X SERIES

Trailer Refrigeration Units With Standard Microprocessors

62-10450 Rev E Change 11/2008

Carrier

TRANSICOLD

OPERATION AND SERVICE MANUAL

NOSEMOUNT

TRAILER REFRIGERATION UNITS

WITH STANDARD MICROPROCESSORS

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SECTION 1 - SAFETY

1.1 SAFETY PRECAUTIONS

Your Carrier Transicold refrigeration unit has been designed with the safety of the operator in mind. During normal operation, all moving parts are fully enclosed to help prevent injury. During all pre-trip inspections, daily inspections, and problem troubleshooting, you may be exposed to moving parts. Please stay clear of all moving parts when the unit is in operation and when the unit main power switch is in the START/RUN position.

⚠ CAUTION

Under no circumstances should anyone attempt to repair the Logic or Display Boards. Should a problem develop with these component, contact your nearest Carrier Transicold dealer for replacement.

⚠ CAUTION

Under no circumstances should a technician electrically probe the processor at any point, other than the connector terminals where the harness attaches. Microprocessor components operate at different voltage levels and at extremely low current levels. Improper use of voltmeters, jumper wires, continuity testers, etc. could permanently damage the processor.

⚠ CAUTION

Most electronic components are susceptible to damage caused by electrical static discharge (ESD). In certain cases, the human body can have enough static electricity to cause resultant damage to the components by touch. This is especially true of the integrated circuits found on the truck/trailer microprocessor.

Auto-Start

Your refrigeration unit is equipped with Auto-Start in both Start–Stop and Continuous Run modes. The unit may start at any time when the Start/Run–Off Switch (SROS) is in the Start/Run position. A buzzer will sound for 5 seconds before the unit is started. When performing any check of the refrigeration unit (e.g., checking the belts, checking the oil), make certain that the SROS is in the OFF position.

Engine Coolant

The engine is equipped with a pressurized cooling system. Under normal operating conditions, the coolant in the engine and radiator is under high pressure and is very hot. Contact with hot coolant can cause severe burns. Do not remove the cap from a hot radiator. If the cap must be removed, do so very slowly in order to release the pressure without spray.

Refrigerants

The refrigerant contained in the refrigeration system of your unit can cause frostbite, severe burns, or blindness when in direct contact with the skin or eyes. For this reason, and because of legislation regarding the handling of refrigerants during system service, we recommend that whenever your unit requires service of the refrigeration system you contact your nearest Carrier Transicold authorized repair facility for service.

Battery

This unit is equipped with a lead-acid type battery. The battery normally vents small amounts of flammable hydrogen gas. Do not smoke when checking the battery. A battery explosion can cause serious physical harm and/or blindness.

1.2 SPECIFIC WARNING AND CAUTION STATEMENTS

To help identify the label hazards on the unit and explain the level of awareness each one carries, an explanation is given with the appropriate consequences:

DANGER – warns against an immediate hazard which WILL result in severe personal injury or death.

WARNING – warns against hazards or unsafe conditions which COULD result in severe personal injury or death.

CAUTION – warns against potential hazard or unsafe practice which could result in minor personal injury, or product or property damage.

The statements listed below are specifically applicable to this refrigeration unit and appear elsewhere in this manual. These recommended precautions must be understood and applied during operation and maintenance of the equipment covered herein.

⚠ WARNING

Do not attempt to service the DataLink module. Breaking the warranty seal will void the warranty.

⚠ WARNING

Beware of V-belts and belt driven components as the unit may start automatically. Before servicing unit, make sure the Start/-Run - Off switch is in the OFF position. Also disconnect the negative battery cable.

⚠ WARNING

Under no circumstances should ether or any other starting aids be used to start engine.

⚠ WARNING

Inspect battery cables for signs of wear, abrasion or damage at every Pre-Trip inspection and replace if necessary. Also check battery cable routing to ensure that clamps are secure and that cables are not pinched or chafing against any components.

⚠ WARNING

Keep hands and arms away from unit when operating without belt guard in place. Never release a unit for service without the belt guard securely tightened in place.

⚠ WARNING

Do not start unit without installing the evaporator panels as unit damage or body harm may result.

⚠ WARNING

Do not use a disposable refrigerant container to store the charge as an explosion may occur.

⚠ WARNING

Never run unit with discharge service valve frontseated.

Never remove fill plug with pressure in compressor.

⚠ WARNING

Do not use a nitrogen cylinder without a pressure regulator. Cylinder pressure is approximately 159.9 Bars (2350 PSIG). Do not use oxygen in or near a refrigerant system as an explosion may occur. (See Figure 6-29)

⚠ WARNING

Personal protection equipment must be utilized when performing coil cleaning.

⚠ CAUTION

Observe proper polarity when installing battery, negative battery terminal must be grounded. Reverse polarity will destroy the rectifier diodes in alternator. As a precautionary measure, disconnect positive battery terminal when charging battery in unit. Connecting charger in reverse will destroy the rectifier diodes in alternator.

⚠ CAUTION

Remove DataLink module and unplug all wire harness connectors before performing any arc welding on any part of the unit.

Do not remove wire harness from module unless you are grounded to the unit frame with a static safe wrist strap.

⚠ CAUTION

When changing oil filters, the new filters should be primed (partially filled) with clean oil if possible. If the filters are not primed, the engine may operate for a period with no oil supplied to the bearings.

⚠ CAUTION

Unit uses R404A and POE oil. The use of inert gas brazing procedures is mandatory for all Carrier Transicold refrigeration units; otherwise compressor failure will occur. For more information Refer to Technical Procedure 98-50553-00 Inert Gas Brazing.

⚠ CAUTION

Use only ethylene glycol anti-freeze (with inhibitors) in system as glycol by itself will damage the cooling system. Always add pre-mixed 50/50 anti-freeze and water to radiator/engine. Never exceed more than a 60% concentration of anti-freeze. Use a low silicate anti-freeze meeting GM specifications GM 6038M for standard life coolant or use Texaco Havoline extended life coolant or any other extended life coolant which is Dexcool approved and has 5/150 (5 years/150,000 miles) on the label.

⚠ CAUTION

Do not get anti-seize oil/compound onto clutch contact surfaces. Thoroughly clean off oil/compound with contact or brake cleaner if this occurs.

⚠ CAUTION

Only a refrigerant drum containing R404a should be connected to an XTC refrigeration unit in order to pressurize the system. Any other gas or vapor will contaminate the system which will require additional purging and evacuation of the high side (discharge) of the system.

⚠ CAUTION

Do not vapor charge R404a systems. Only liquid charging through the receiver (King) valve is acceptable.

⚠ CAUTION

Do not over tighten or damage the enclosing tube assembly. Torque to 17-ft pounds (23 Nm). Also make sure all parts are placed on the enclosing tube in proper sequence to avoid premature coil burnout.

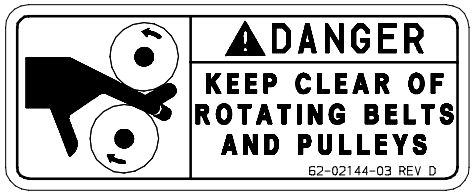
⚠ CAUTION

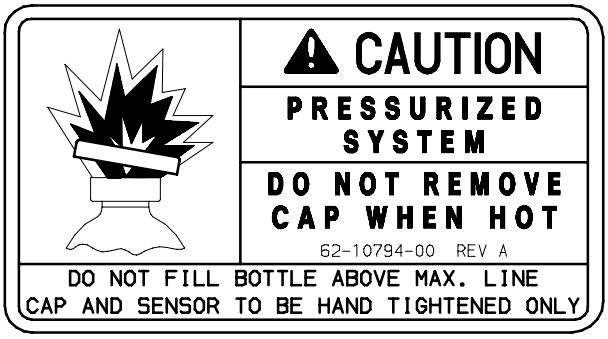
Do not drill out the logic board standoffs to remove the plastic cover. Permanent damage to the microprocessor will result.

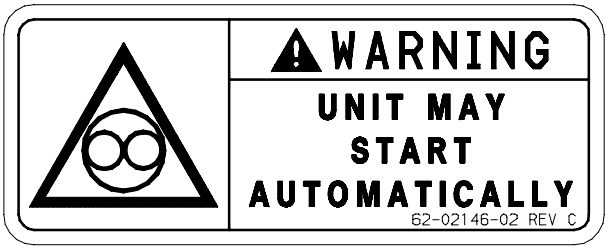
⚠ CAUTION

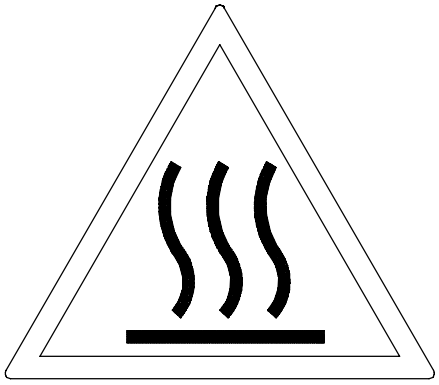
Do not allow the insulated jumper wire be used to configure unit to touch any ground.

1.3 SAFETY DECALS

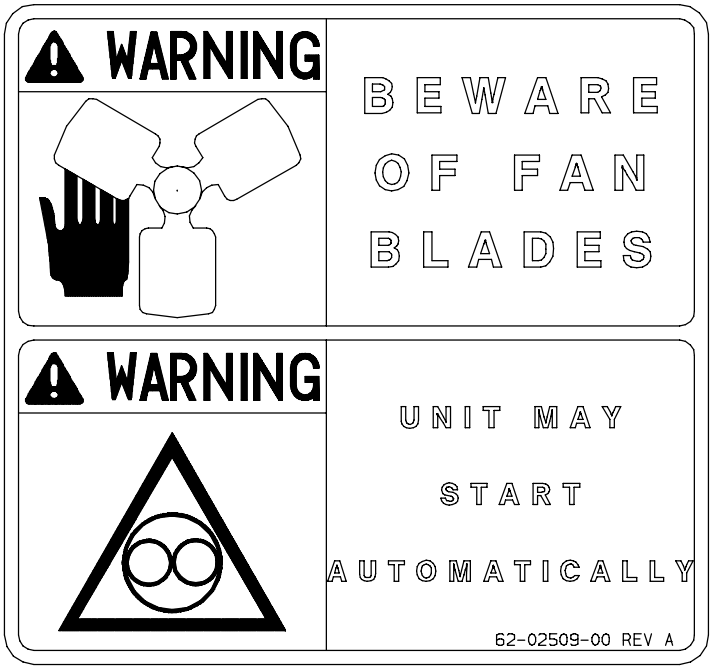


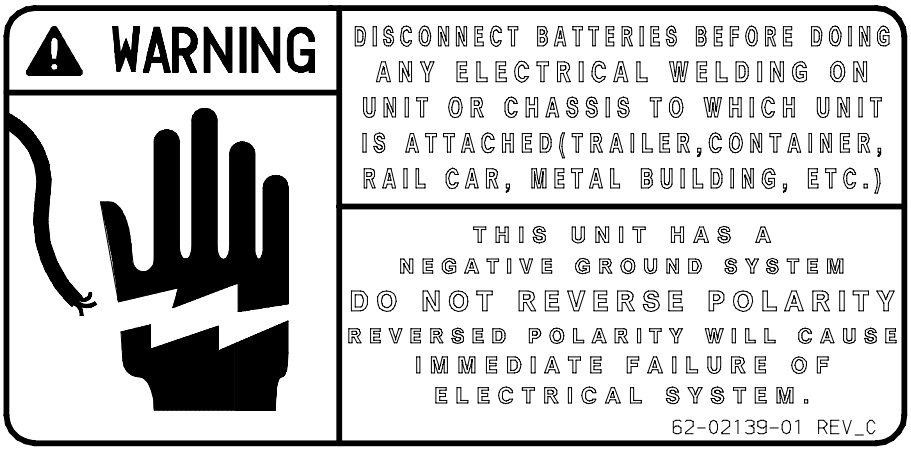


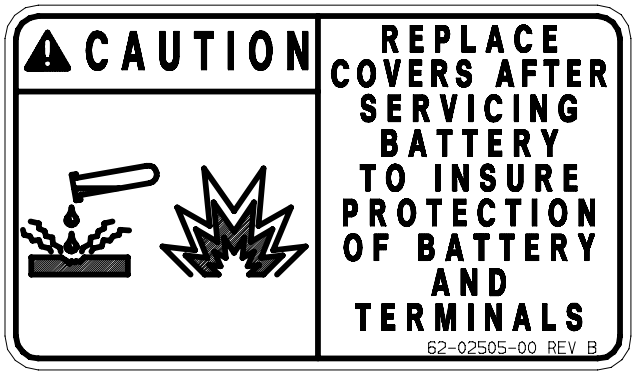




62-03958-00 Heat Warning




WARNING
DISCONNECT BATTERIES BEFORE DOING ANY ELECTRICAL WELDING ON UNIT OR CHASSIS TO WHICH UNIT IS ATTACHED(TRAILER,CONTAINER, RAIL CAR, METAL BUILDING, ETC.)
THIS UNIT HAS A
NEGATIVE GROUND SYSTEM
DO NOT REVERSE POLARITY
REVERSED POLARITY WILL CAUSE IMMEDIATE FAILURE OF ELECTRICAL SYSTEM.
62-02139-01 REV_C


CAUTION
REPLACE COVERS AFTER SERVICING BATTERY TO INSURE PROTECTION OF BATTERY AND TERMINALS
62-02505-00 REV B

SECTION 2 - UNIT DESCRIPTION

2.1 INTRODUCTION

⚠ WARNING

Beware of V-belts and belt driven components as the unit may start automatically. Before servicing unit, make sure the Run - Stop switch is in the STOP position. Also disconnect the negative battery cable.

This manual contains Operating Data, Electrical Data and Service Instructions for the refrigeration units listed in Table 2-1.

Additional support manuals are listed in Table 2-2.

The model/serial number plate is located inside the unit on the frame as shown in Figure 2-3.

2.2 GENERAL DESCRIPTION

The unit is a one piece, self-contained, fully charged, pre-wired, refrigeration/heating "nosemount" diesel powered unit for use on insulated trailers to maintain cargo temperatures within very close limits.

Table 2-1. Model Chart

Models	Refrigerant R-404A		Compressor	Engine	Engine Speed	
	LB	KG			High	Low
Extra XT NDL-93E	20	9	05G 37cfm	CT4-114-TV	1700	1350
Extra XT NDL-93N (Special Order)				CT4-134-DI		
Ultra XT NDL-93M			05G 41 cfm	CT4-134-DI		
X2 1800 NDL-93W (Special Order)	20	9	05G 37cfm	V1903-IDI ESC		
X2 1800 NDL-93S	20	9	05G 37cfm	V2203-DI ESC		
X2 2100 NDL-93S			05G 41cfm			

Table 2-2. Additional Support Manuals

Manual Number	Equipment Covered	Type of Manual
62-10451	Extra XT	Parts List
62-10647	Ultra XT	Parts List
62-11169	X2 1800/2100	Parts List
62-10601	Units With Standard Microprocessor	Operator's Manual
62-10600	Units With Standard Microprocessor	Easy To Run
62-10295	Engine V2203-DI Extra and Ultra XT	Parts List
62-10864	Engine 1903 E2B - Extra XT	Parts List
	Engine 2203 E2B - Ultra XT	Parts List
62-10863	Engine V2203-DI (Tier 2)	Parts List
62-11168	Engine (Electronic Speed Control)	Parts List
62-10301	Engine	Workshop
62-10866	Engine 1903 E2B - Extra XT	Workshop
	Engine 2203 E2B - Ultra XT	Workshop
62-10865	Engine (Tier 2)	Workshop
62-11167	Engine (Electronic Speed Control)	Workshop
62-10299	Compressor	Parts List
62-11053	Compressor (05G TWINPORT))	Parts List
62-02756	Compressor	Workshop
62-11052	Compressor (05G TWINPORT)	Workshop

Heating is accomplished by circulating hot gas directly from the compressor to the evaporator coil. Three electric solenoid valves control the refrigerant circuit to operate the heating/cooling system.

Automatic evaporator coil defrosting is initiated by either sensing the air pressure drop across the coil with a differential air switch or with the defrost timer in the microprocessor.

The control box include manual switches, microprocessor, fuses, and associated wiring. Also, the unit can be equipped with an optional remote light bar which mounts separately on the front roadside corner of the trailer.

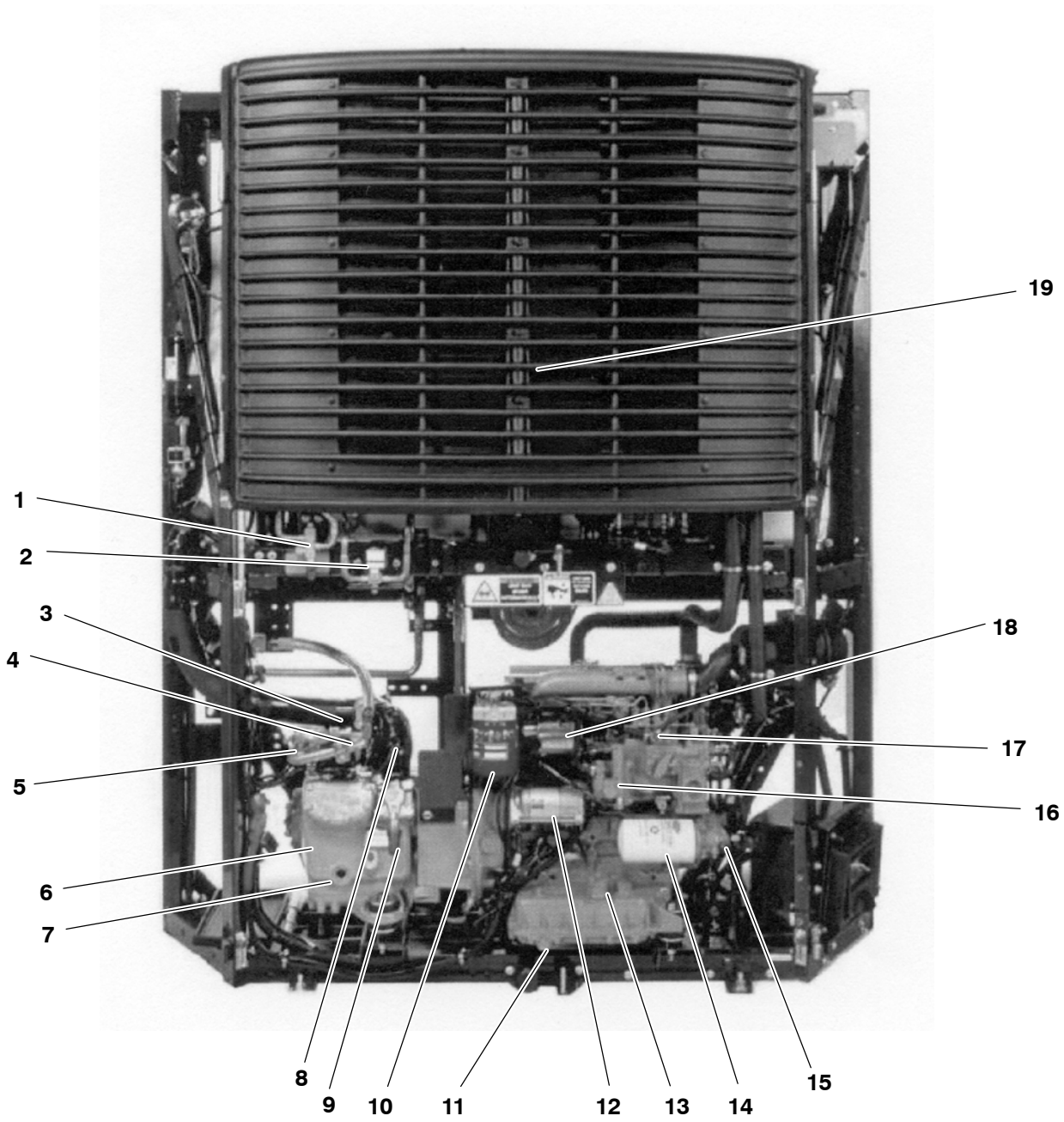
The temperature controller is a microprocessor solid state controller (Refer to Section 2.5). Once the controller is set at the desired temperature, the unit will operate automatically to maintain the desired temperature within very close limits. The control system automatically selects high and low speed cooling or high and low speed heating as necessary to maintain the desired temperature within the trailer.

The refrigeration compressor used is either a 05G 37cfm or 41cfm depending on unit model (see Table 2-1 above), equipped with unloaders as standard equipment. Unloaders are used as a compressor capacity control to unload the compressor during periods of reduced loads. This provides closer temperature control, reduces potential for top freezing and reduces power required to operate the compressor; thus reducing fuel consumption.

NOTE

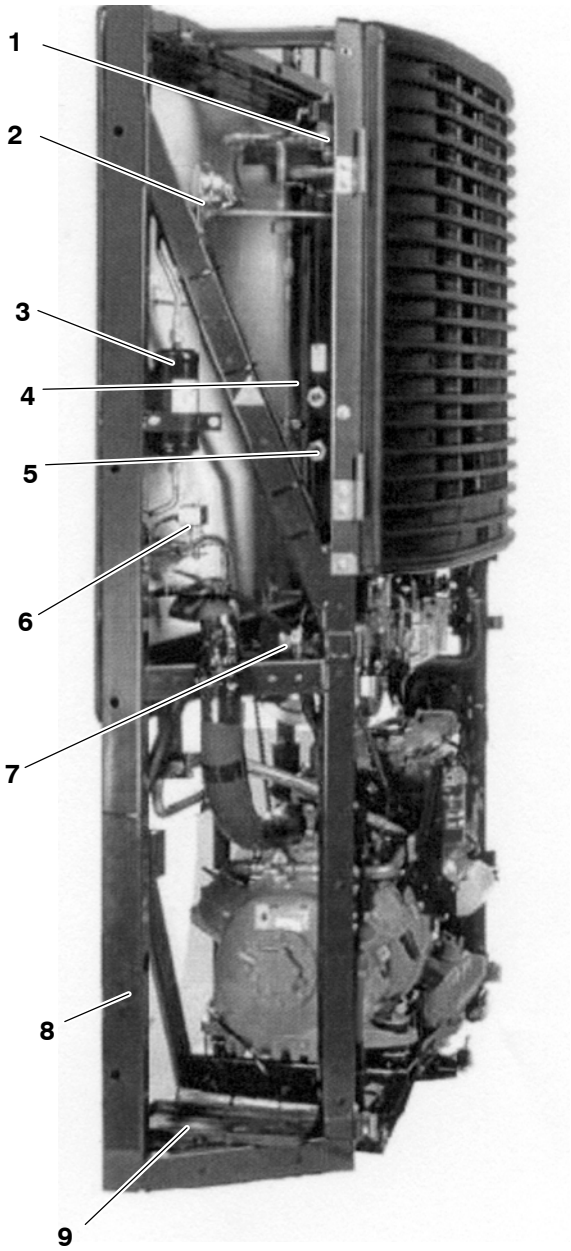
Throughout this manual, whenever the “left” or “right” hand side of the engine is referred to, it is the side as viewed from the flywheel end of the engine.

The auto start/stop operation provides automatic cycling of the diesel engine, which in turn offers an energy efficient alternative to continuous operation of the engine with control of temperature by alternate cooling and heating of the supply air (evaporator outlet air). The auto start/stop feature is standard equipment.



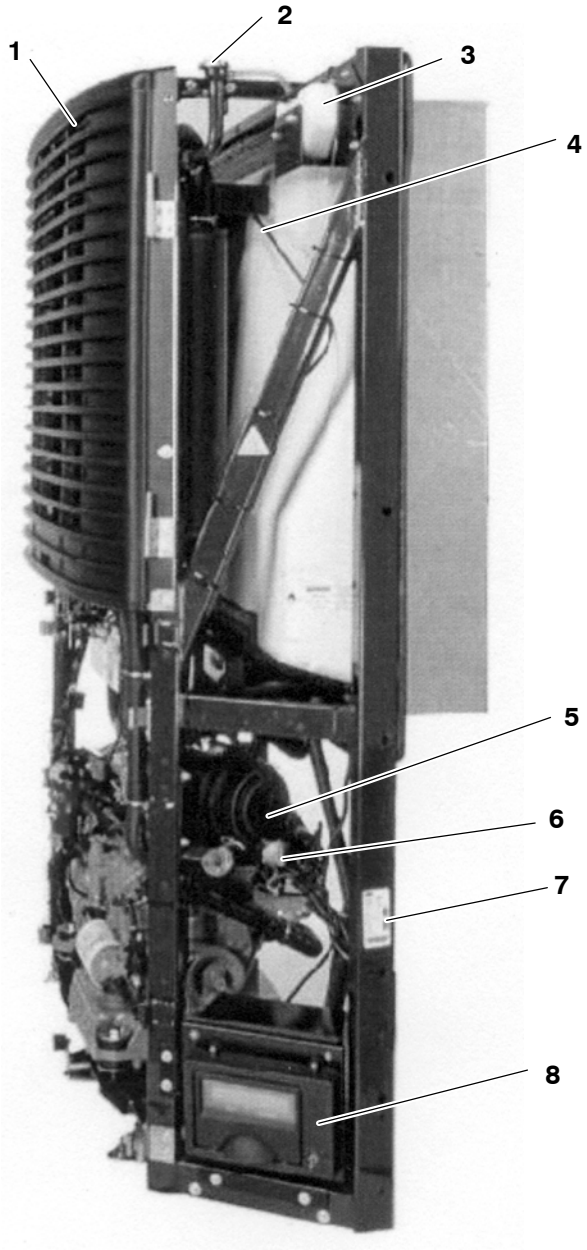
1	King Valve	10	Fuel Filter
2	Hot Gas Solenoid Valve (SV-4)	11	Oil Drain
3	Unloader Solenoid Valve	12	Starter Motor
4	High Pressure Cutout Switch (HP-1) and Head Pressure Control Switch (HP-2)	13	Lube Oil Fill & Dipstick
		14	Lube Oil Filter
5	Discharge Service Valve	15	Oil Pressure Switch (OP)
6	Compressor – 05G	16	Mechanical Fuel Pump
7	Compressor Sight Glass	17	Fuel Bleed Valve
8	Suction Pressure Transducer (SPT)	18	Speed Control Solenoid (SCS)
9	Suction Service Valve	19	Ambient Temperature Sensor (ATS)

Figure 2-1. Front View Of Unit With Non ESC Engine



1. Condenser Pressure Control Solenoid Valve (SV-1)
2. Defrost Air Switch
3. Filter-Drier
4. Receiver
5. Receiver Sight Glass
6. Liquid Line Solenoid Valve (SV-2)
7. Discharge Check Valve
8. Model/Serial No. Location (prior to HAH90553679)
9. Battery Location

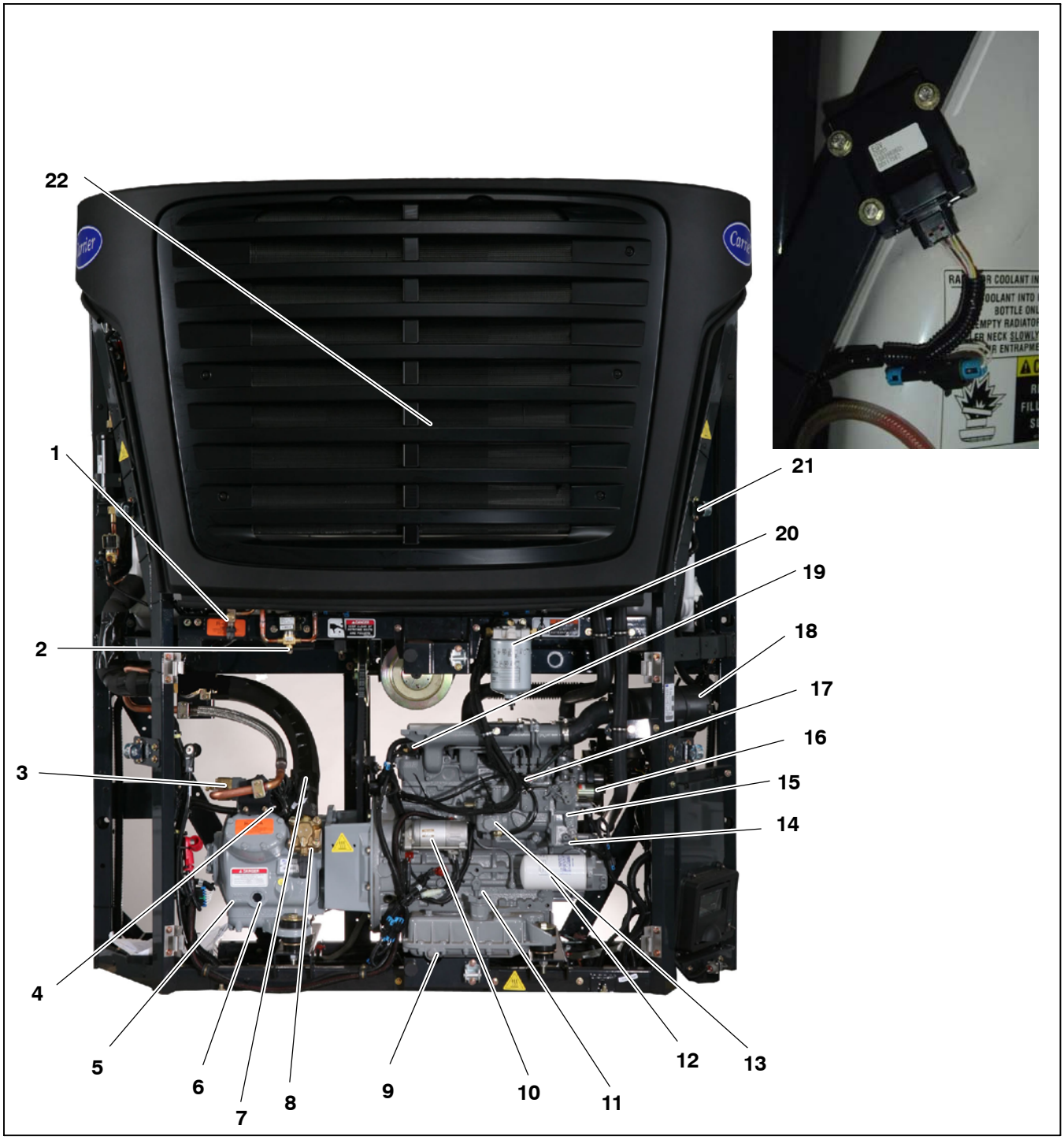
Figure 2-2. Curbside



1. Condenser/Radiator
2. Radiator Fill Neck
3. Radiator Overflow Reservoir
4. DataLink Recorder Location (Optional) – See Figure 2-18
5. Engine Air Cleaner
6. Alternator – See Figure 2-9
7. Model/Serial No. Location (starting with HAH90553679)
8. Control Box – See Figure 2-12

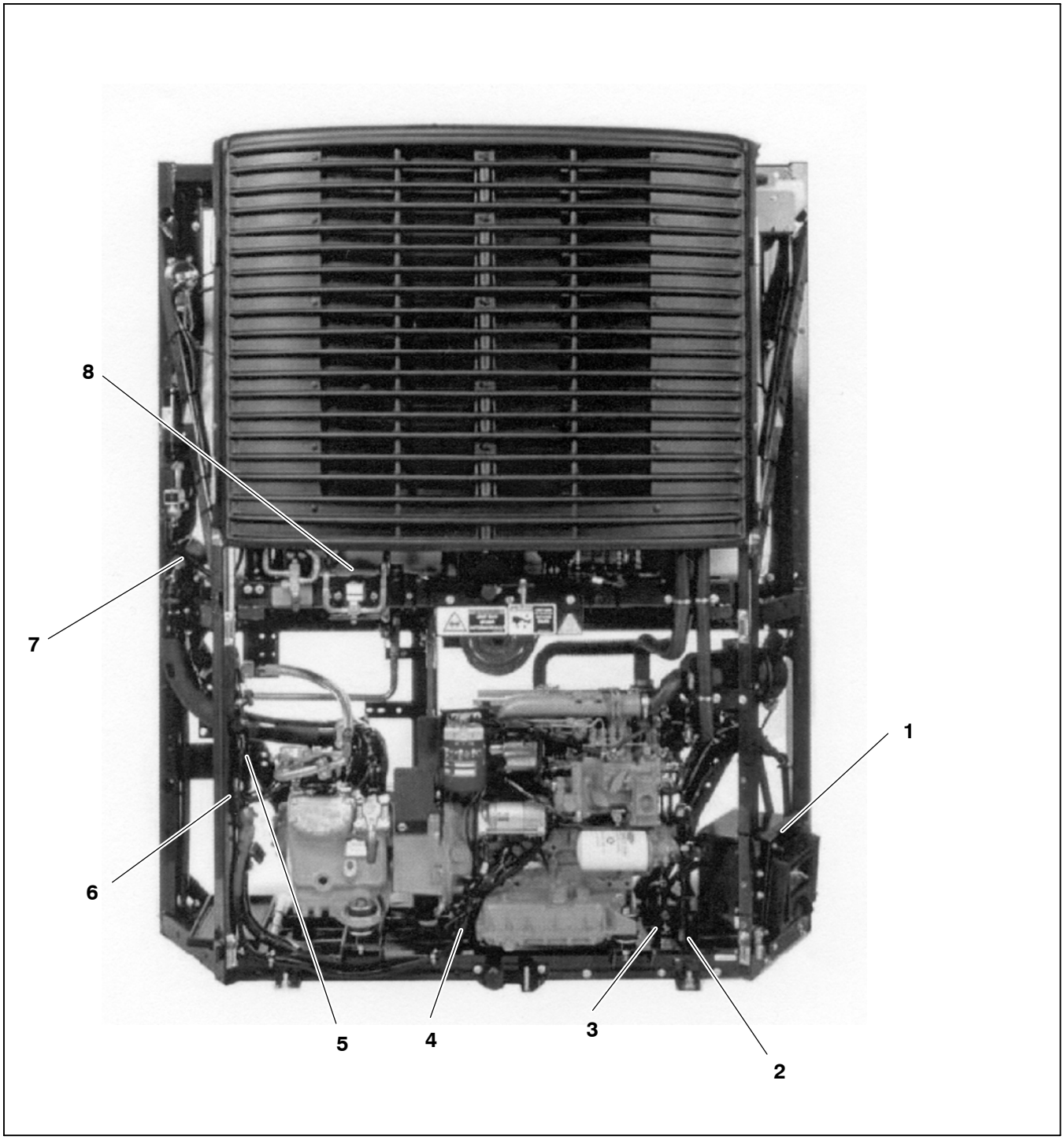
Figure 2-3. Roadside

UNIT WITH NON-ESC ENGINE SHOWN



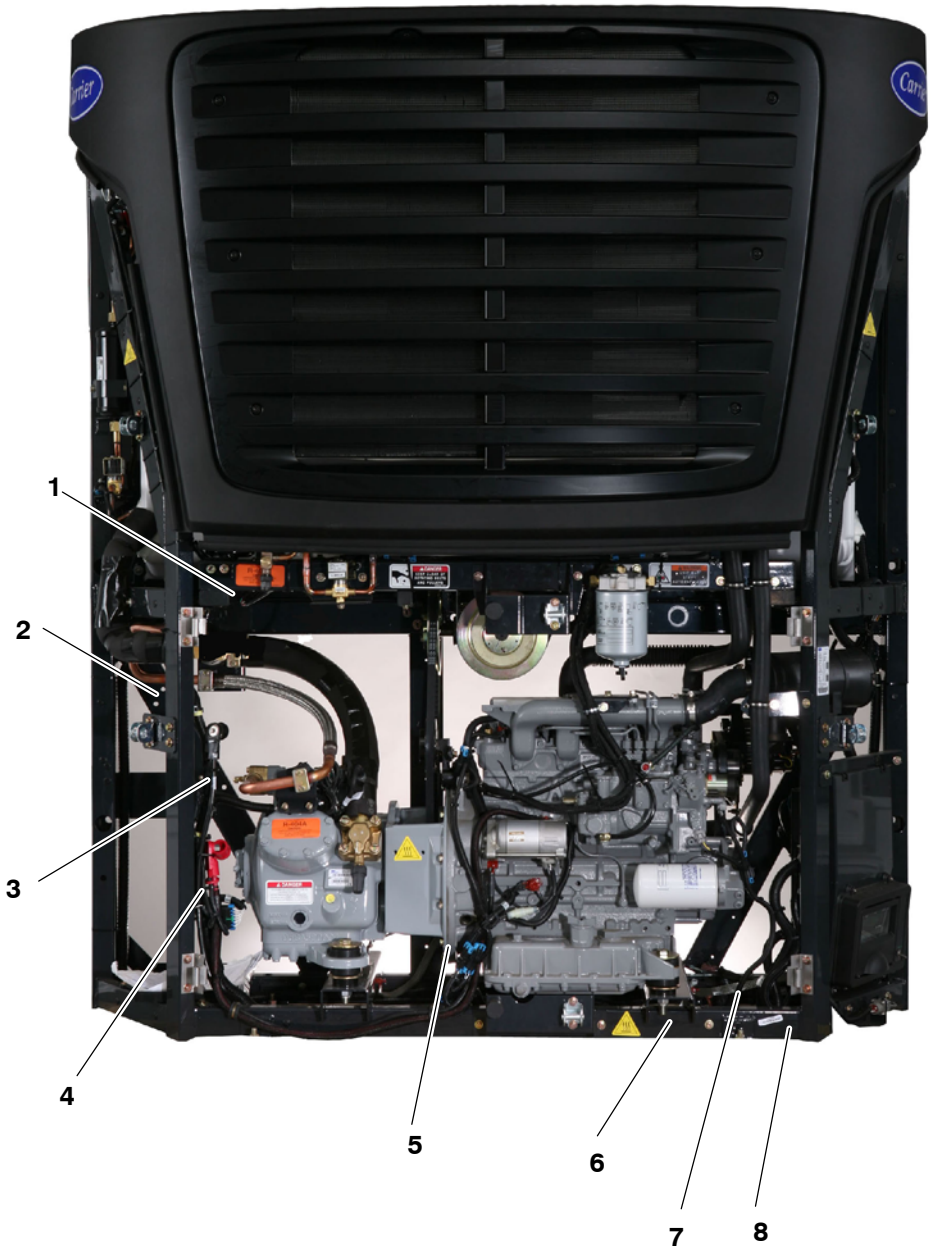
1. King Valve
2. Hot Gas Solenoid Valve (SV4)
3. Discharge Service Valve
4. Compressor Discharge Transducer (CDT), High Pressure Cutout Switch (HP1 and HP2) and Unloader Solenoid Valve
5. Compressor – 05G
6. Compressor Sight Glass
7. Suction Pressure Transducer (CSP)
8. Suction Service Valve
9. Engine Oil Drain
10. Starter Motor
11. Lube Oil Fill and Dipstick
12. Lube Oil Filter
13. Mechanical Fuel Pump
14. Oil Pressure Switch (OP)
15. Engine Speed Sensor (ENSSN)
16. Fuel and Speed Actuator (FSA)
17. Fuel Bleed Valve
18. Engine Air Cleaner
19 Water Temperature Sensor (WTS)
20. Fuel Filter
21. Location of Engine Speed Control Unit
22. Ambient Air Temperature (AAT)

Figure 2-4. Front View Of Unit With Electronic Speed Control



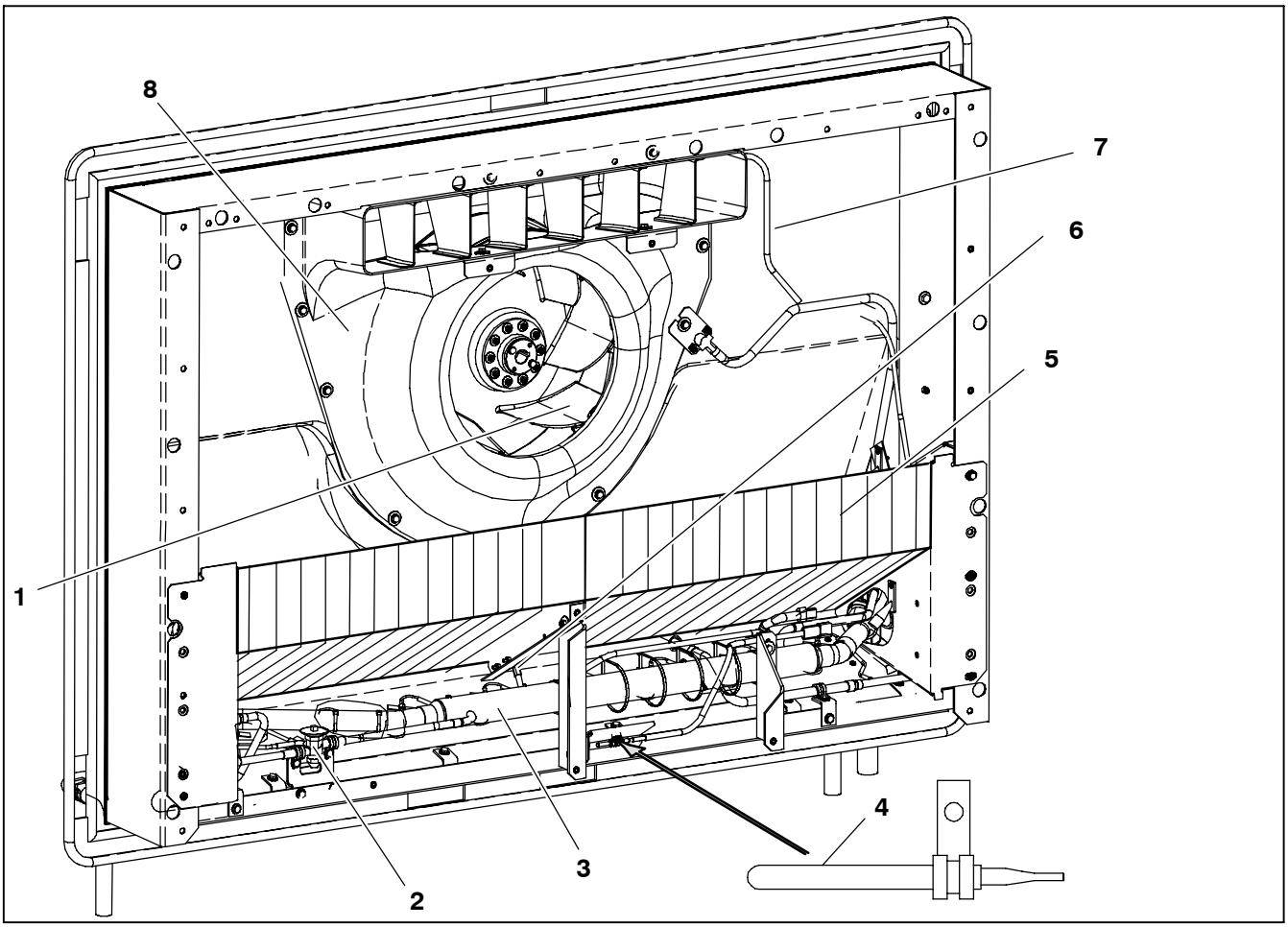
1. SP1, 2 & 3 – Off of white connector out of back of micro
2. SP6 – Under micro mount – next to the right engine mount
3. SP5 – In wiring harness for the fuel solenoid
4. SPK 6 – Left of the oil pan
5. SPK 8 –Ty–wrapped to wiring harness – left of compressor
6. SP8 – Left of compressor cylinder head
7. SPK 18 – Ty wrapped to harness leading to SV2
8. SP 19 – Behind SV4

Figure 2-5. Ultra XT and Extra XT Splice Pack Locations



1. SPK 19 – On main harness near king valve
2. SPK 18 – On main wiring harness above door latch
3. SPK 8 – On engine wiring harness – left of and above compressor
4. SP8 – On engine wiring harness left of the compressor discharge
5. SPK 6 – On engine harness left of the oil pan
6. SP9 – On main harness under the engine mount
7. SP1, 2 & 3 – On J1 harness (white connector from micro)
   SP14 – A breakout on the J1 harness leading to the DataLink connector
8. SPK 20 On the main harness between the micro & engine

Figure 2-6. X2 Splice Pack Locations



1. Evaporator Fan (Blower Wheel)
2. Expansion Valve
3. Heat Exchanger
4. Return Air Sensor (RAS)
5. Evaporator Coil
6. Defrost Termination Thermostat(s) (DTT)
7. Supply Air Sensor (SAS)
8. Nozzle Cover

Figure 2-7. Evaporator Section – Panels and Grille Removed

2.3 CONDENSING SECTION

The condensing section consists of an engine-compressor drive package, condenser fan, condenser/radiator coil, refrigerant controls, piping, wiring, defrost air switch, and associated components.

The drive equipment includes the engine, clutch, air cleaner, muffler, coolant overflow bottle, and drive belts.

Refrigeration components mounted in the condensing section include the compressor, defrost air switch, filter drier, and receiver.

2.3.1 Engine

The diesel engine drives the compressor directly through a nylon drive gear and adapter. The adapter also includes a V-belt sheave which drives the gearbox. The condenser/evaporator fan shaft is driven with a V-belt from the gearbox. The water pump V-belt drives the alternator.

The engine (refer to Section 2.8) gives excellent fuel economy and has easy starting characteristics. It is equipped with spin-on lube oil and fuel oil filters for easier filter changes.

Engine Transducers and Sensors:

a. Oil Pressure Safety Switch (OP)

This normally open switch allows the engine to operate when oil pressure is above 15 $\pm$ 3 PSIG (1.02 $\pm$ 0.2 Bars). The switch will open and automatically stop the engine 5 seconds after pressure drops below 12.3 $\pm$ 3 PSIG (0.84 Bar). There is a 15-second delay after the engine starts to allow the oil pressure to build up before the microprocessor looks at the input from this switch. The switch is located on the front of the engine below the fuel solenoid.

b. Water Temperature Sensor (WTS)

Provides micro with engine coolant temperature information to be displayed and recorded in the DataRecorder . The sensor is located on the starter side of the engine near the #4 Injector.

c. Engine Speed Control Unit (ENSCU) (ESC only) (See Figure 2-8)

The ENSCU is mounted on the roadside frame behind the door. It provides the RPM signal to the microprocessor. The unit has an alarm LED incorporated within it, which is used to diagnose failures within the ESC system. See Section 5.4 for information on diagnosing failures.

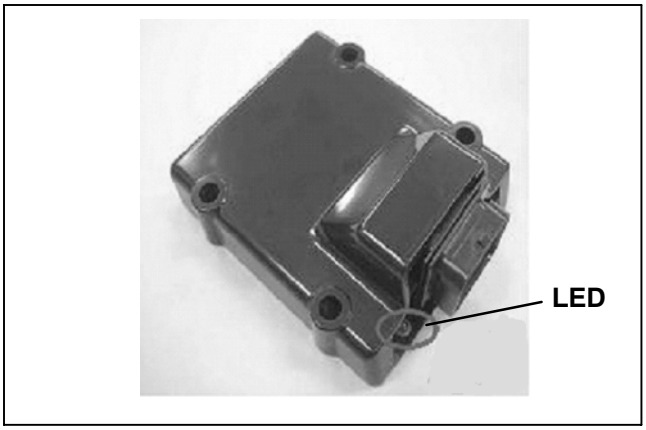


Figure 2-8. Frame Mounted Engine Speed Control Unit (ENSCU)

d. Fuel and Speed Actuator (FSA) (ESC only)

The FSA combines the fuel shutoff solenoid and speed control solenoid into one component. Engine speed is controlled by varying rod position.

e. Engine Speed Sensor (ENSSN) (ESC only)

The ENSSN provides the RPM signal to the ENSCU for speed control. It is located on the front of the engine in the gear case cover.

2.3.2 Alternator/Regulator

Electrical power for the control system and for charging the battery is provided by the 12 VDC alternator.

a. Alternator Operation

⚠ CAUTION

Observe proper polarity when installing battery. Negative battery terminal must be grounded. Reverse polarity will destroy the rectifier diodes in alternator. As a precautionary measure, disconnect positive battery terminal when charging battery in unit. Connecting charger in reverse will destroy the rectifier diodes in alternator.

The alternator converts mechanical and magnetic energy to alternating current (A.C.) and voltage, by the rotation of an electromagnetic field (rotor) inside a three phase stator assembly. The alternating current and voltage is changed to direct current and voltage, by passing AC energy through a three phase, full-wave rectifier system. Six silicon rectifier diodes are used.

The regulator is an electronic switching device. It senses the system voltage level and switches the voltage applied to the field in order to maintain proper system voltage.

b. Integral Voltage Regulator Operation (12 VDC)

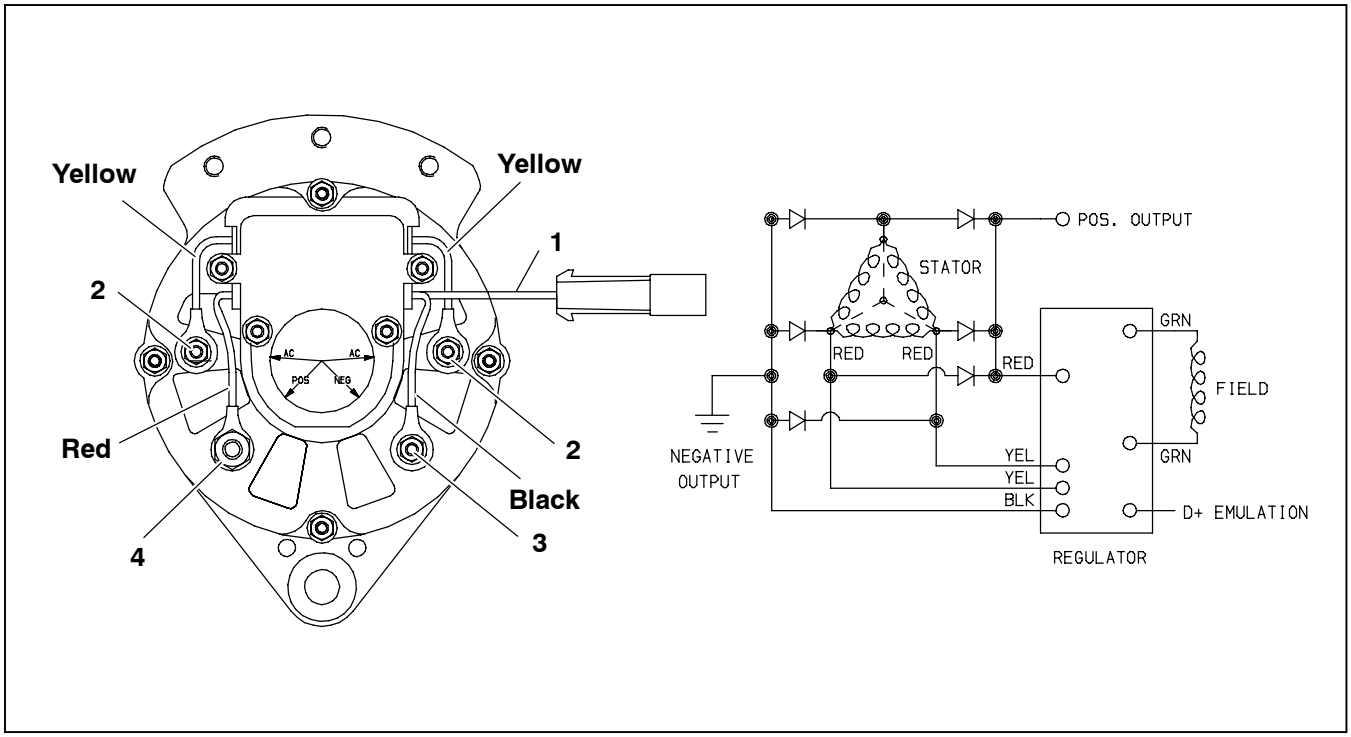
The regulator is an all-electronic, transistorized device. No mechanical contacts or relays are used to perform the voltage regulation of the alternator system. The electronic circuitry should never require adjustment and the solid state active elements used have proved reliable enough to warrant a sealed unit. The system is temperature compensated to permit the ideal charging rate at all temperatures.

The D+ circuit provides a voltage reading to the micro. The micro looks at two separate inputs to determine if the engine is running:

1) It looks to see that the oil pressure switch is closed.

2) It looks for and alternator ouput voltage on the D+ circuit.

With the unit OFF and the alternator not rotating, the D+ circuit will be 0 VDC. (See 6.9 for information on improper voltage reading.) With the engine running and the alternator rotating, voltage on the D+ circuit will match the charging voltage to the battery. This will be approximately 14.5 VDC.



1. D+ Emulation (Orange)
2. #10-24 AC Terminal
3. #10-24 Ground Screw
4. 1/4-20 Positive Output Cable

Figure 2-9. Alternator and Regulator

2.3.3 Compressor

The compressor assembly includes the refrigerant compressor, suction and discharge service valves, high pressure switch, and the suction pressure transducer. The compressor withdraws refrigerant gas from the evaporator and delivers it to the condenser at an increased pressure and temperature. The pressure is such that refrigerant heat can be absorbed by the surrounding air at ambient temperatures.

Compressor Unloaders

The refrigeration compressor used is a 37 or 41 cfm model 05G, equipped with unloaders as standard equipment. Unloaders are used as a compressor capacity control to unload the compressor during periods of reduced loads. This provides closer temperature control, reduces potential for top freezing and reduces power required to operate the compressor; thus reducing fuel consumption.

a. Major Working Parts

- Solenoid and valve system
- Spring loaded piston type bypass control valve
- Spring loaded discharge check valve

b. Unloaded Operation

Pressure from the discharge manifold (Figure 2-10, item 15) passes through the strainer (9) and bleed orifice (8) to the back of the piston bypass valve (7). Unless bled away, this pressure would tend to close the piston (6) against the piston spring (5) pressure.

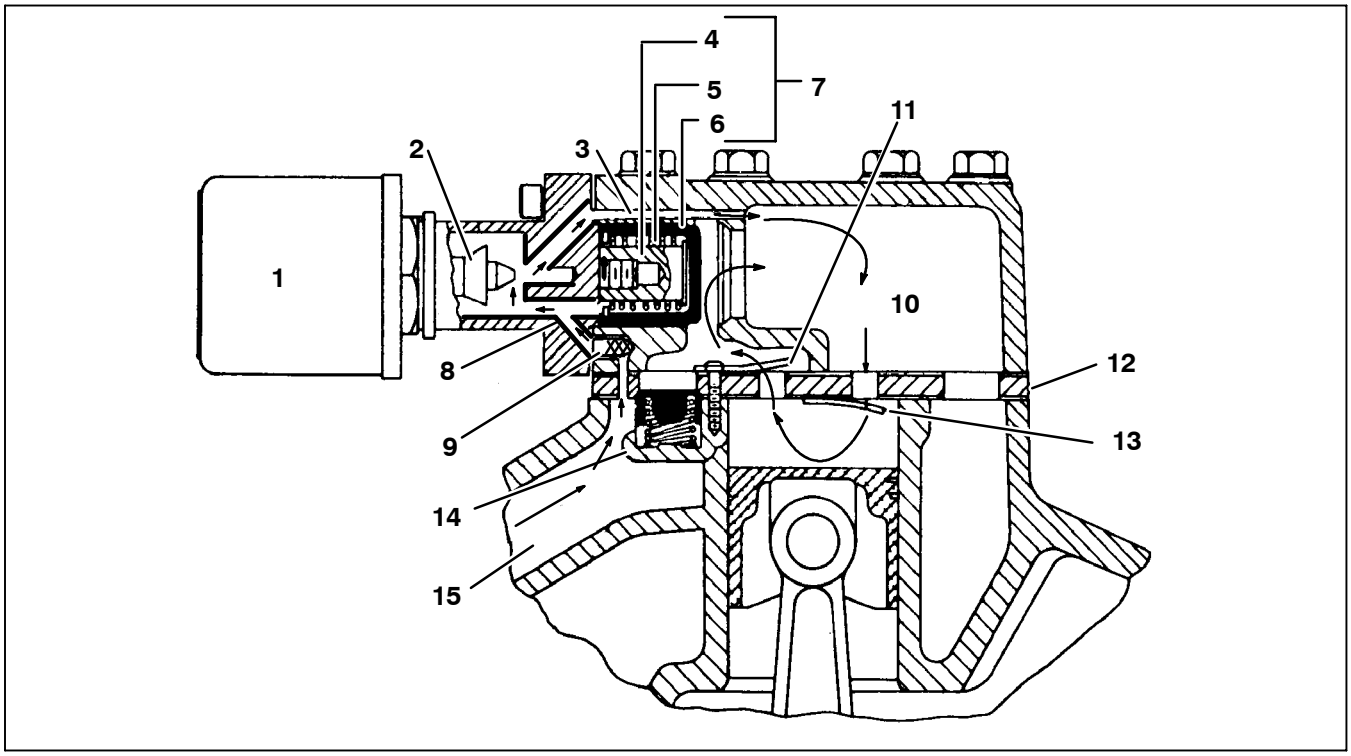
With the solenoid valve (1) *energized* the solenoid valve stem (2) will *open* the gas bypass port (3).

Refrigerant pressure will be bled to the suction manifold (10) through the opened gas bypass port . A reduction in pressure on the piston bypass valve will take place because the rate of bleed through the gas bypass port is greater than the rate of bleed through the *bleed orifice* (8).

When the pressure behind the piston has been reduced sufficiently, the valve spring will force the piston bypass valve *back*, *opening* the gas bypass from the discharge manifold to the suction manifold.

Discharge pressure in the discharge manifold will close the discharge piston check valve assembly (14) isolating the compressor discharge manifold from the individual cylinder bank manifold.

The *unloaded* cylinder bank will continue to operate *fully unloaded* until the solenoid valve control device is *de-energized* and the gas bypass port is closed.



1. Solenoid Valve
2. Valve Stem
3. Gas Bypass Port
4. Spring Guide
5. Spring
6. Piston
7. Piston Bypass Valve
8. Bleed Orifice
9. Strainer
10. Suction Manifold
11. Cylinder Discharge Valve
12. Valve Plate
13. Cylinder Suction Valve
14. Discharge Piston Check Valve Assembly
15. Discharge Manifold

Figure 2-10. Compressor Cylinder Head Unloaded

c. Loaded Operation

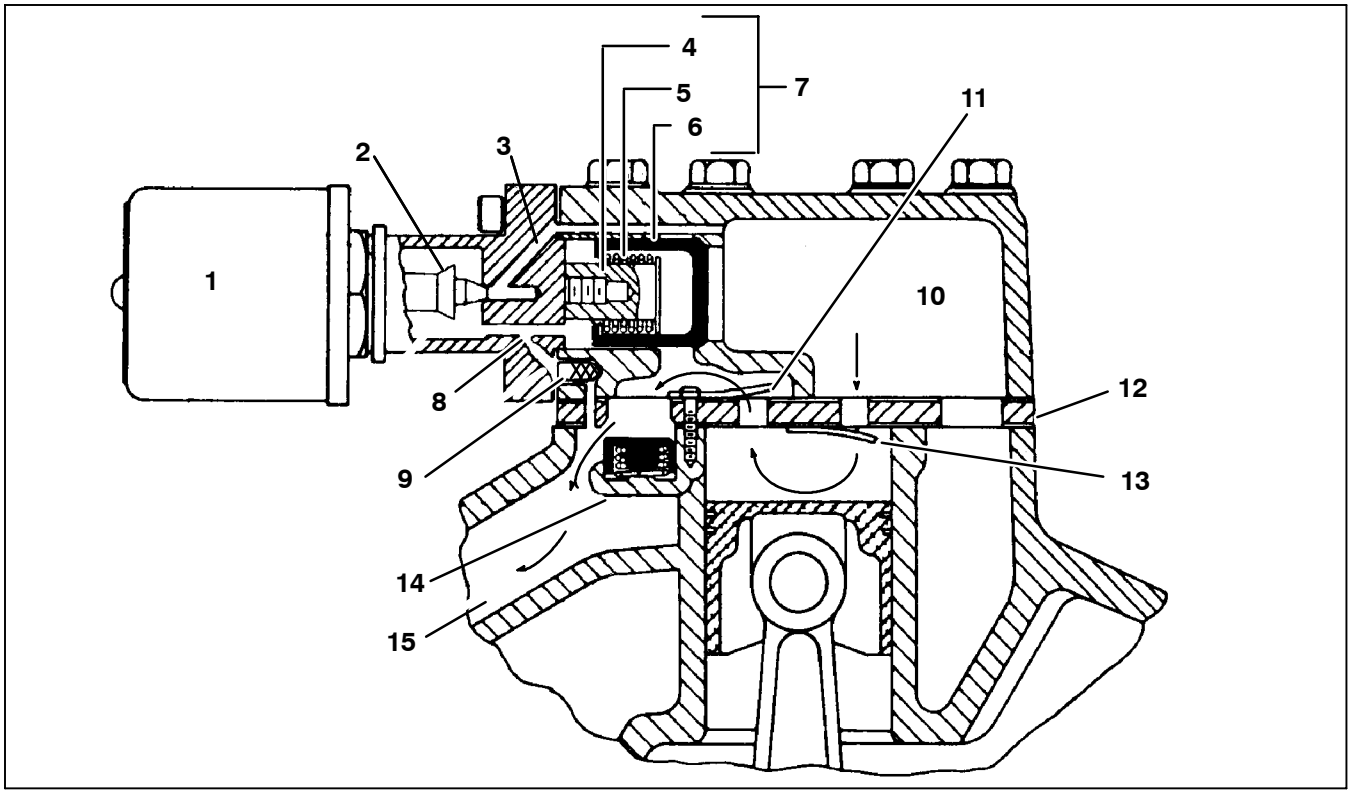
Discharge pressure bleeds from the discharge manifold (Figure 2-11, item 15) through the strainer (9) and (8) bleed orifice to the solenoid valve stem (2) chamber and the back of the piston bypass valve (7).

With the solenoid valve (1) *de-energized* the solenoid valve stem will *close* the gas bypass port (3).

Refrigerant pressure will overcome the bypass valve spring (5) tension and force the piston (6) *forward* *closing* the gas bypass from the discharge manifold to the suction manifold (10).

Cylinder discharge pressure will force open the discharge piston check valve assembly (14). Refrigerant gas will pass into the compressor discharge manifold.

The loaded cylinder bank will continue to operate fully loaded until the solenoid valve control device is energized and the gas bypass port is opened.



1. Solenoid Valve
2. Valve Stem
3. Gas Bypass Port
4. Spring Guide
5. Spring
6. Piston
7. Piston Bypass Valve
8. Bleed Orifice
9. Strainer
10. Suction Manifold
11. Cylinder Discharge Valve
12. Valve Plate
13. Cylinder Suction Valve
14. Discharge Piston Check Valve Assembly
15. Discharge Manifold

Figure 2-11. Compressor Cylinder Head Loaded

2.3.4 Filter Drier

The drier is a cylinder shell containing a drying agent and screen. It is installed in the liquid line and functions to keep the system clean and remove moisture from the refrigerant.

2.3.5 Receiver

Liquid refrigerant from the condenser is pushed into the receiver by system pressure. The receiver serves as a liquid reservoir when there are surges due to load changes in the system; as a storage space when pumping down the refrigeration system.

The receiver is provided with either one or two sight glass(es) for the observation of liquid level, and a fusible plug safety device.

2.3.6 Transducers and Sensors

a. **Compressor Suction Pressure Transducer (SPT)**

Provides micro with suction pressure information to be displayed, recorded in the DataRecorder and used to control the refrigeration system. It cannot be calibrated. It is located near the oil pump on the compressor.

b. Ambient Air Temperature Sensor (ATS)

ATS is a temperature control probe which provides micro with ambient air temperature information to be displayed, recorded in the DataRecorder and used to control the refrigeration system. It is located behind the condenser grille.

c. Compressor Discharge Temperature Sensor Transducer (CDT)

Provides micro with discharge temperature information to be displayed, recorded in the DataRecorder and used to control the refrigeration system. It is located on the center cylinder head of the compressor.

It will shut the unit down if center compressor head discharge temperature reaches 310°F (154°C) for three minutes or 350°F (177°C). If ambient temperature sensor (AAT) is at 120°F (49°C) or higher, the CDT limits are increased to 340°F (171°C) for three minutes.

2.4 EVAPORATOR SECTION

The evaporator fits into a rectangular opening in the upper portion of the trailer or rail car front wall. When installed, the evaporator section is located inside this box, and the condensing section is outside.

The evaporator assembly consists of an evaporator coil, evaporator fan, expansion valve, two defrost thermostats (termination switches). The location of the thermostats is shown in Figure 2-7. The return air sensor is also shown in Figure 2-7.

2.4.1 Thermal Expansion Valve

The thermal expansion valve is an automatic device which controls the flow of liquid to the evaporator according to changes in superheat to the refrigerant leaving the evaporator. The thermal expansion valve maintains a relatively constant degree of superheat in the gas leaving the evaporator regardless of suction pressure. Thus, the valve has a dual function; automatic expansion control and prevention of liquid return to the compressor.

2.4.2 Heat Exchanger

The heat exchanger is of the “tube in tube” type connected in the main suction line and liquid line. Within the heat exchanger, the cold suction gas is used to cool the warm liquid refrigerant. This results in greater system capacity and efficiency.

2.4.3 Evaporator Coil

The unit evaporator is a tube and fin type. The operation of the compressor maintains a reduced pressure within the coil. At this reduced pressure, the liquid refrigerant evaporates at a temperature sufficiently low enough to absorb heat from the air.

Heating is accomplished by circulating hot gas directly from the compressor to the evaporator coil. Solenoid valves control the refrigerant circuit to operate the heating/cooling system.

Automatic evaporator coil defrosting is initiated by either sensing the air pressure drop across the coil with a differential air switch or with the defrost timer in the microprocessor.

2.5 SYSTEM OPERATING CONTROLS AND COMPONENTS

The temperature controller is a Carrier Transicold controller (Refer to Sections 2.5.2 and 3.1). Once the controller is set at the desired temperature, the unit will operate automatically to maintain the desired temperature within very close limits.

The microprocessor that is shown on the electrical schematic interfaces with unit components.

Plug-in interchangeable relays provide the microprocessor with a means for switching the unit components to achieve a desired operating mode.

The control box includes manual switches, microprocessor, fuses, and associated wiring. Also, the unit can be equipped with an optional remote light bar which mounts separately and can be seen in the mirror from the cab of a truck, or on the front of a rail car.

Standard equipment includes an auto start–stop feature. This feature provides automatic cycling of the diesel engine, which in turn offers an energy efficient alternative to continuous operation of the engine with control of temperature by alternate cooling and heating of the supply air (evaporator outlet air).

2.5.1 Special Features

The following special features are incorporated into the Carrier Transicold Advance Microprocessor:

- A MessageCenter which clearly displays all information in LCD form.
- Unit Operation and Alarms are displayed in English or codes.
- UltraFresh 2
- Large LCD display
- Unit Data and Functional Parameters
- Programmable Maintenance hourmeters
- PM Hourmeters are resettable from the keypad
- Bright LED alarm light
- Bright LED mode lights
- Fully automated Pretrip
- Auto Start-Stop
- Automatic Engine Starting. Manual engine starting exists in units built before April 2007.
- Functional Parameter locks
- A communication link to transmit unit operational data to a remote computer. Refer to Section 2.7

The Carrier Transicold microprocessor controller incorporates the following features:

a. Control supply or return air temperature to tight limits by providing refrigeration control, heat and defrost to ensure conditioned air delivery to the load.
b. Dual independent readouts of set point and supply or return air temperatures.
c. Digital readout and ability to select data. Refer to 3.8 for Function Code and 3.9 for Unit Data.
d. For alarm digital display identification refer to 3.10.
e. A pre-trip checkout of refrigeration unit operation. Refer to Section 3.3
f. A self-test check on program memory and data memory. The self-test is executed each time the system is switched from “Stop” to “Start.” Errors, if any, shall be indicated on the display as a ERR.X, where X is a number corresponding to the number of the test. The unit shall display this error for 5 seconds and then reset the micro.

ERROR	CAUSE
ERR.1 ERR.2 ERR.3	Processor failure Check chip installation or Replace microprocessor.
ERR.4 or Display	Display board to logic board communication failure. This can be caused by a defective ribbon cable or ribbon cable not plugged in properly.

2.5.2 Component Description And Location

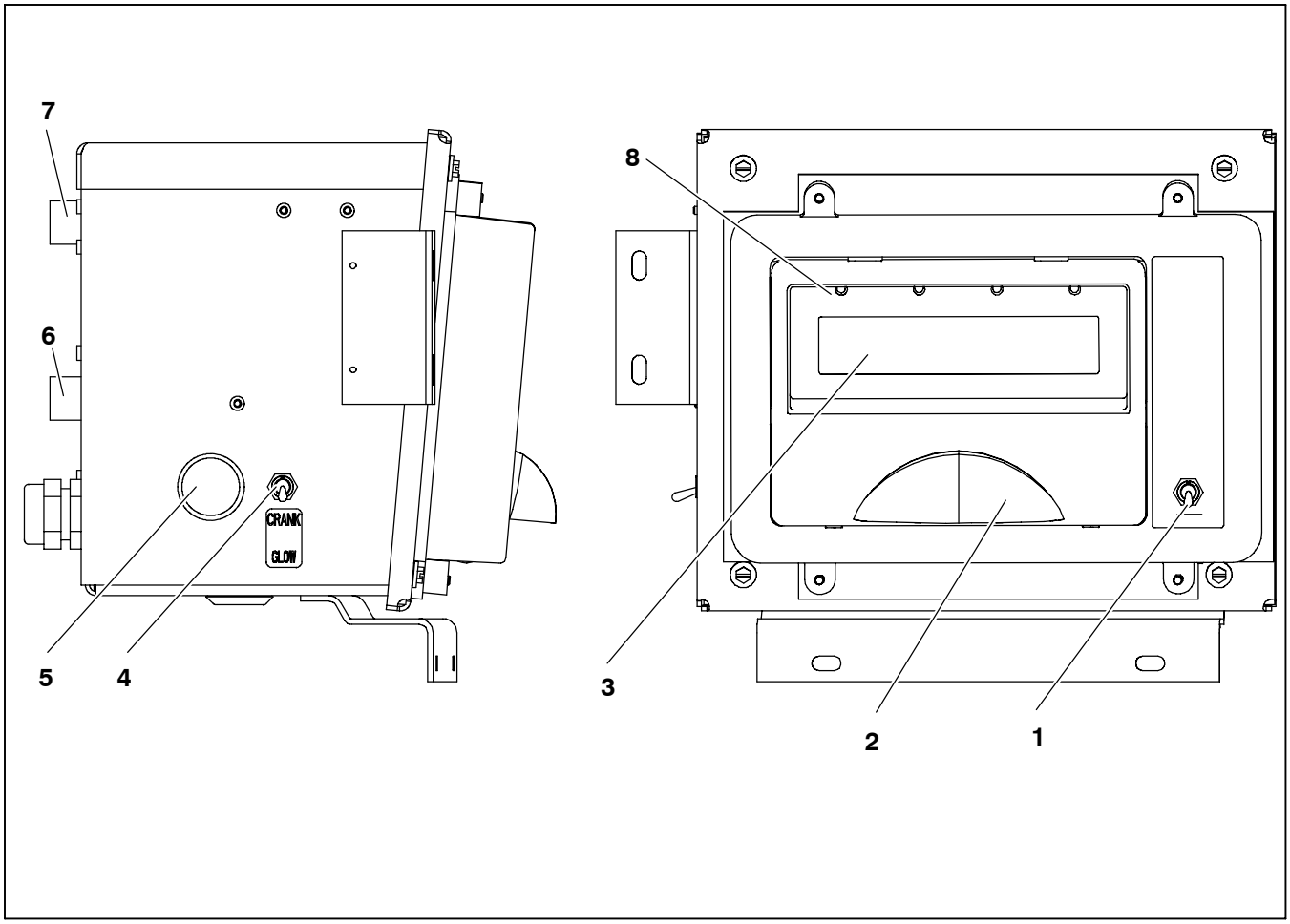
⚠ CAUTION

Under no circumstances should anyone attempt to repair the Logic, Relay or Display Boards! (see section 6.31) Should a problem develop with these components, contact your nearest Carrier Transicold dealer for replacement.

The microprocessor controller is housed in the control box on the lower roadside corner of the unit. This controller consists of 3 control boards:

a. The Logic Board includes the microprocessor, program memory, and necessary input/output circuitry to interface with the unit.
b. The Display Board (Figure 2-16) is mounted in the same control box as the processor board. The display board includes the LCD display, keypad and keypad interface.
c. The Relay Board (Figure 2-14) is mounted to the back of the control box, into which replaceable relays, and fuses are mounted. The main wiring harness plugs into this board.

The microprocessor (Figure 2-15) is totally self-contained and does not contain any serviceable components.



1. Run-Stop Switch (RS)
2. Keypad Door
3. Microprocessor Control Panel (See Figure 2-16)
4. Manual Glow/Crank Switch (MGC) (If equipped)
5. Buzzer (B)
6. J2 Plug
7. J1 Plug
8. Fault Light

Figure 2-12. Control Box (Short Box Shown)

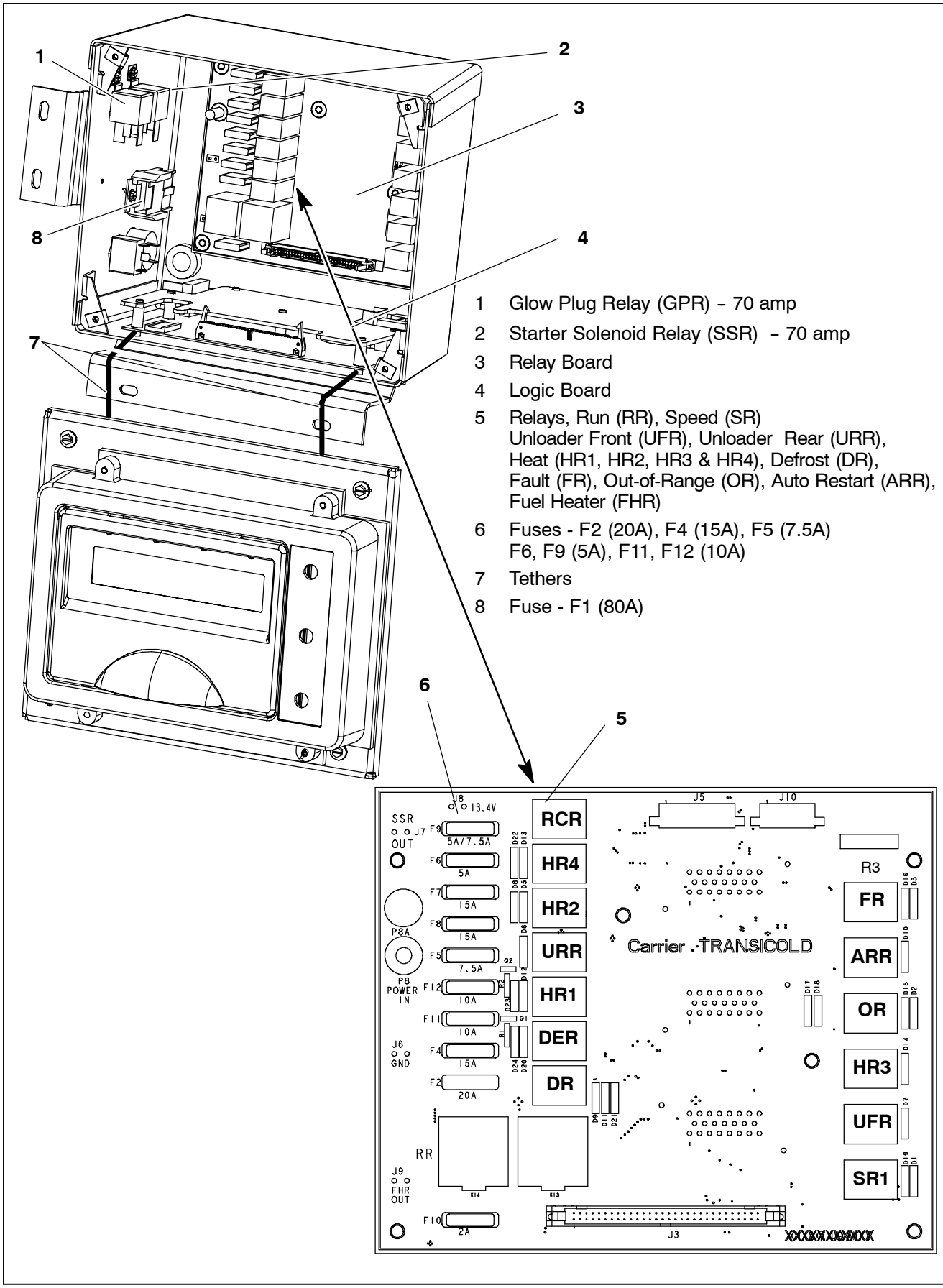


Figure 2-13. Control Box – (Short Box)

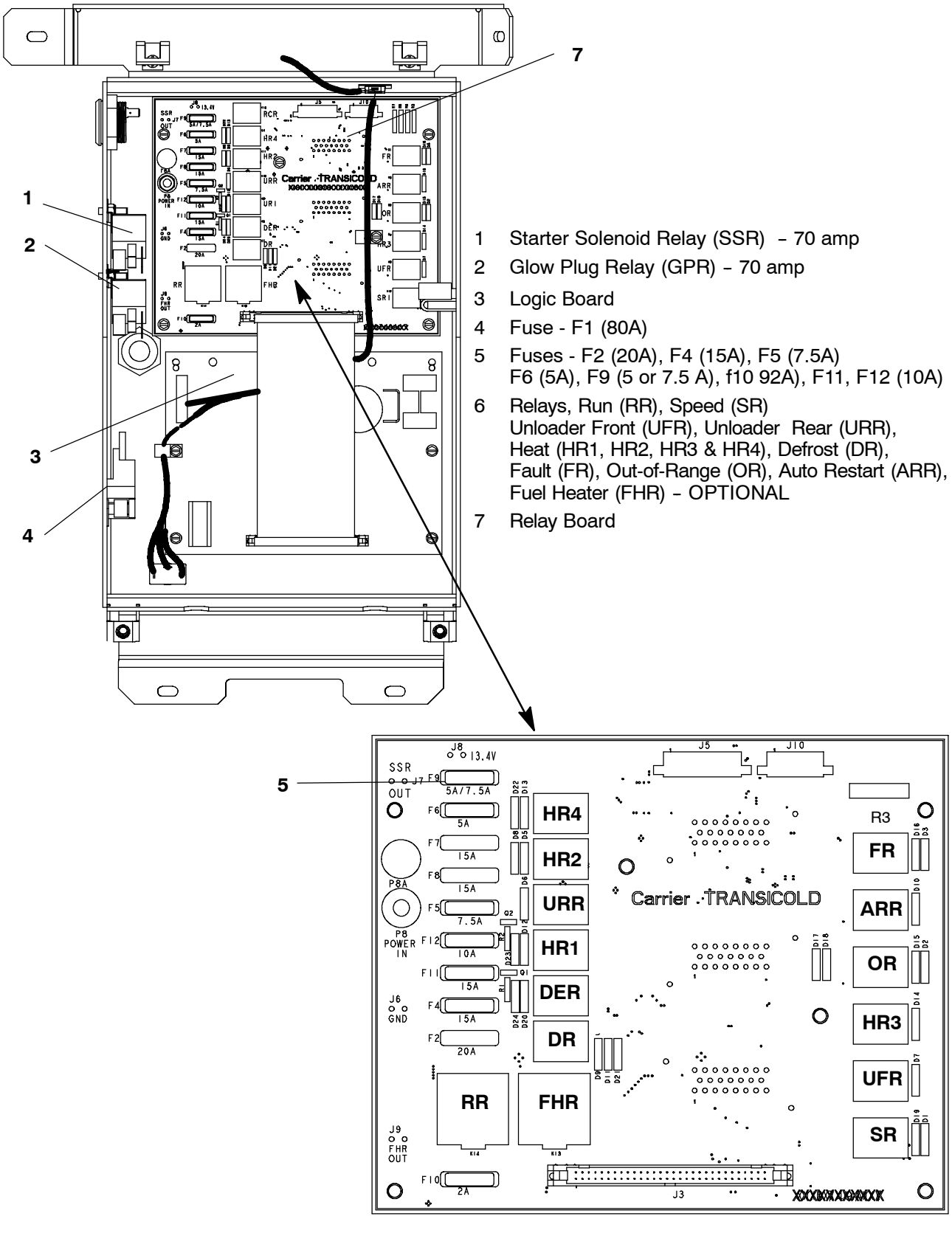


Figure 2-14. Control Box – Redesigned Tall Box

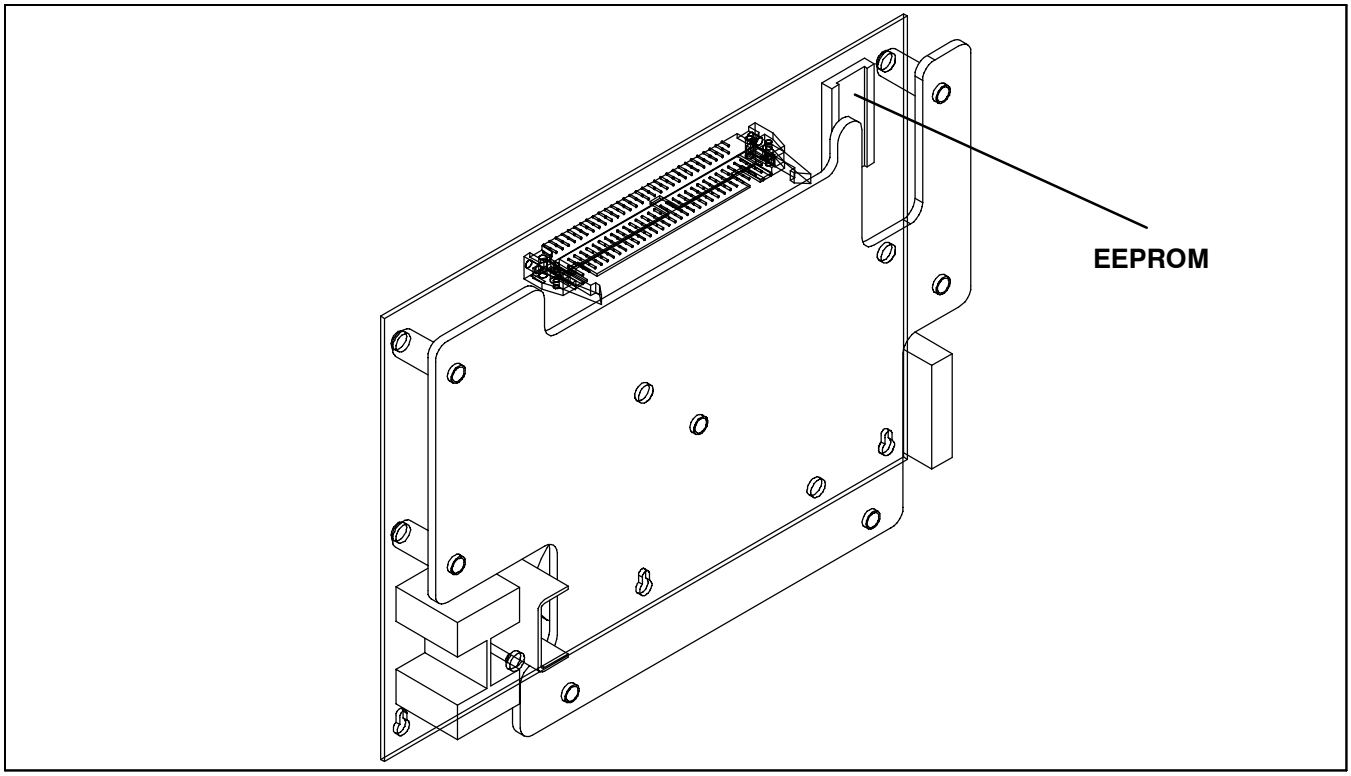


Figure 2-15. Logic Board

d. Display and Keypad

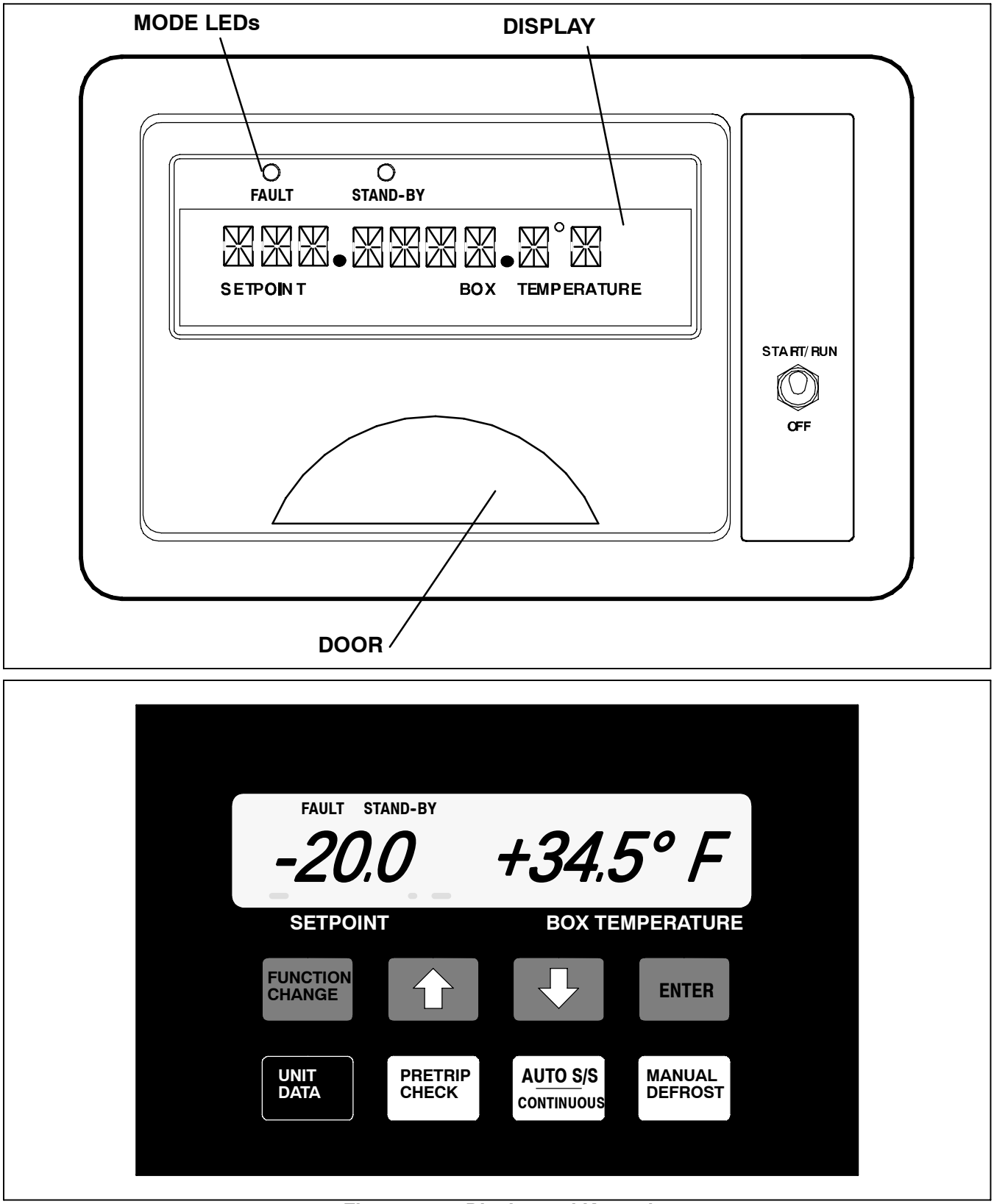


Figure 2-16. Display and Keypad

The Display and Keypad module is located for operator access at the lower roadside corner of the unit.

The display board is mounted in the Keypad and Display module. The display board includes the LCD display, keypad, and keypad interface.

The Display and Keypad module provides the user with a panel to view and control the functions of the refrigeration unit. The module consists of a switch, keypad, and main display. Setpoints and other system information are selected using the keypad. Figure 2-16 shows the Display and Keypad module.

Display

The main display has nine characters (each character has 14 elements), two decimal points or commas and a degree symbol. The display is used to provide the user a setpoint and box temperature, either in degrees Centigrade or Fahrenheit. The comma symbols are used as the decimal indicators in Europe. When Metric Units is selected in the Functional Parameters, the two comma icons are used instead of decimal points. When English Units is selected in the Functional Parameters, decimal points are used.

The display illuminates the entire LCD segment when the Ru/Stop switch (RS) is turned OFF. The design appears as shown in the display graphic of Figure 2-16. As the internal capacitor discharges the LCD segments fade out to a blank display. Some units have a change in information displayed while the capacitor is discharging. Instead of the snowflake pattern, the display could initially show the snowflake display for a few seconds and then display the same data that was being displayed at the time the unit was turned off. For example, if an alarm was being displayed it may be displayed again.

Temperature display is right justified, with unused digits blank. A negative sign will be displayed for all setpoint and box temperatures below zero. The resolution for box temperature in both Centigrade and Fahrenheit is one-tenth degree.

Indicator LEDs

The display has two LEDs across the top to indicate operation status. These indicators are:

- Fault – Indicates there is an alarm.
- Stand–By – Unit running on Stand–by (Not applicable for X series units.)

Switch Descriptions

RUN/STOP Switch

When placed in the RUN position, this switch provides power to the microprocessor. The microprocessor performs a self-test (all segments of display are illuminated). Then setpoint and Box Temperature are displayed. To stop the unit or remove power from the microprocessor, move the run-stop switch to the STOP position.

GLOW/CRANK Switch (MGC) (Removed From Units Built after April, 2007)

The GLOW/CRANK switch is located on the side of the control box.

NOTE

The manual glow/crank switch when held in the GLOW position, energizes (approximately 7.5 amps per plug at 12 vdc) the glow plugs in the engine to pre-heat the combustion chamber. The CRANK position of the switch is used to manually engage the engine starter.

Key Descriptions

The keypad has 8 keys which will allow the operator to initiate various functions, display operating data and change operating parameters.

UP ARROW and DOWN ARROW Keys

These keys allow you to change the setpoints or other displayed data of the system. They also allow you to scroll through the Unit Data List, Function Parameters List, Alarm List, etc.

EQUAL Key (ENTER)

The EQUAL key is used for many things including entering a setpoint, changing a Functional Parameter, clearing alarms, and locking the data menu.

MANUAL DEFROST Key

The MANUAL DEFROST key is used to initiate a defrost cycle when the proper conditions are met.

AUTO S/S CONTINUOUS

AUTO START–STOP/CONTINUOUS Key

The START/STOP CONTINUOUS key is used to change the operating mode from "auto start/continuous run" to "auto start/stop." Each push of the key will alternate the operating modes. The operating status will be stored in memory and will be retained through power outages. The digital display will indicate when stop/start is enabled (Also See Section 3.5).

To start the unit in manual start mode, the START/STOP CONTINUOUS selection must be in continuous run mode.

PRETRIP CHECK

PRETRIP CHECK Key

Used to initiate a pretrip given that the proper conditions are met. (Refer to Section 3.3).

UNIT DATA

UNIT DATA Key

The UNIT DATA key is used to display the unit operating data. This key, in conjunction with the UP/DOWN Arrow keys, will allow the user to display the unit's operating data values (i.e., coolant temperature, battery voltage, etc.) (See Section 3.9).

FUNCTION CHANGE

FUNCTION CHANGE Key

The FUNCTION CHANGE key is used to display the operating parameters. Each time this key is pressed the display will advance to the next parameter. This key, in conjunction with the UP/DOWN Arrow and ENTER keys, will allow the user to change the parameters (See Section 3.8.1).

e. LIGHT BAR (Optional)

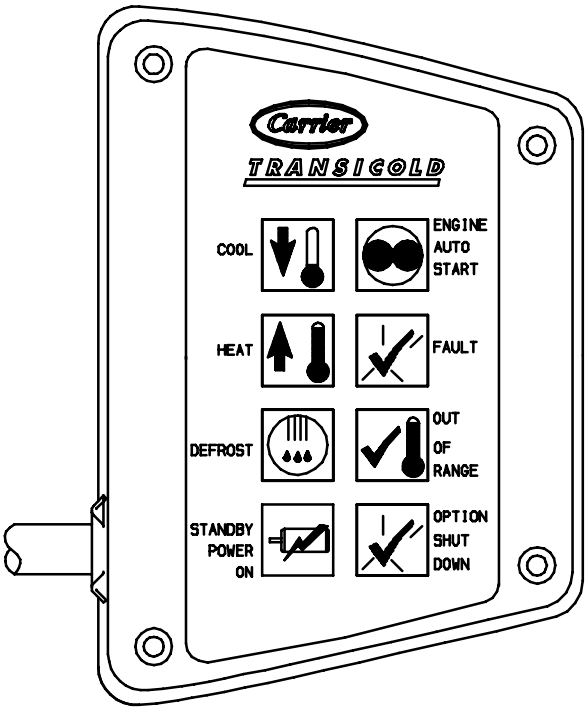
The Light Bar is an external set of indicator lights which can be seen in the mirror from the cab of a truck. (See Figure 2-17.) They are controlled by the microprocessor. The lights are:

Two Light Bar

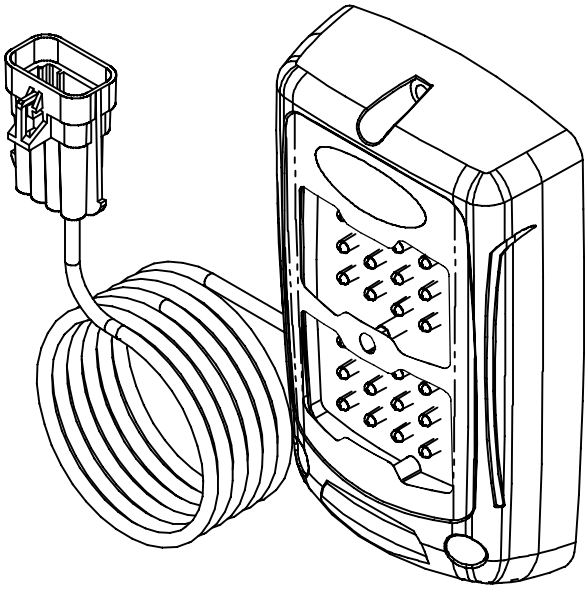
- Green Light – Indicates "OK"
- Amber Light – Indicates "Check Unit". Amber follows the microprocessor fault light and alarms can be read on the micro display.

Eight Light Bar

These lights correspond to the microprocessor LEDs – HEAT, COOL, DEFROST, START-STOP, and ALARM. The ENGINE-AUTO-START light is only illuminated when the unit is operating in Start-Stop. The OUT-OF-RANGE light is illuminated when the Out-of-Range Alarm is active.



STANDARD LIGHT BAR



LED LIGHT BAR

Figure 2-17. Light Bar

2.6 DATALINK MODULE (Optional)

2.6.1 Brief Description

⚠ WARNING

Do not attempt to service the DataLink module. Breaking the warranty seal will void the warranty.

⚠ CAUTION

Remove DataLink module and unplug all wire harness connectors before performing any arc welding on any part of the unit.

Do not remove wire harness from module unless you are grounded to the unit frame with a static safe wrist strap.

Carrier Transicold has developed a recorder "DataLink". it is a self-contained module which consists of:

- Microprocessor
- Program memory
- Data memory
- Internally battery backed real time clock
- 5 thermistor inputs
- Fuel Level inputs
- Door open/closed switch
- Four status LEDs
- Software ports
- Electronic backup power pack

This recorder eliminates the mechanical recorder and paper chart, and replaces it with a custom-designed module (see Figure 2-18) that interfaces with the controller module and the Datalink Toolbox PC based software program.

a. Operate as a stand alone device or as part of a network.

b. Log data at 2, 15, 30, 60 or 120 minute intervals.

c. Log DataLink alarms.

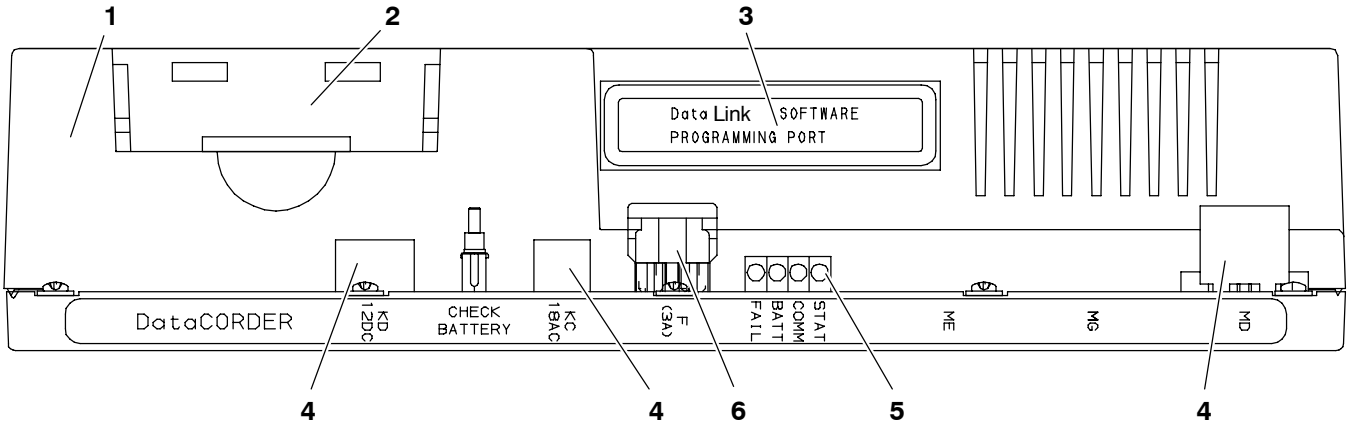
d. Can be custom configured to record up to 13 different sensors.

e. Record DataLink/Network generated events as follows:

- Main Setpoint Change
- Defrost Initiation
- Defrost Termination
- Pre-Trip Initiation
- Pre-Trip Termination
- Alarm Activity
- Controller Software Upgrade
- Controller Replacement
- Trailer ID Change
- Trip Start
- Trip Comment
- Unit Start/Stop
- Controller Configuration Change
- Function Parameter Change
- Controller System Mode Change (diesel/elect)
- Control Mode Change
- In-Range Indicator
- RTC Battery Replaced (Internal Battery)
- Remote 1 Setpoint Change
- Remote 2 Setpoint Change
- DataLink Alarm Activity
- Power off
- Power on
- Data Retrieval
- RTC Modification
- DataLink Software Upgrade
- Network Failure
- Network Recovery
- Door Opened/Closed
- Fuel Level Low/Normal

f. Download files contain the following information:

- Description Header
- DataLink Header
- Memory Configuration
- Current Values
- Alarm Table
- Time and Date
- Selected Event Data
- Recorded Sensor Values



1. DataLink Module
2. Backup Power Pack
3. Software Port
4. Connector
5. Status LEDs
6. Fuse

Figure 2-18. DataLink Module

2.6.2 Components and Descriptions

Operational Software:

DataLink Software controls the unit's operations such as: waking up at a specified time, requesting information from other modules in the unit, taking readings from probes, etc.

Program Flash Cards

The program flash cards are used for installing and upgrading DataLink software.

2.6.3 Functions

a. DataLink Power-Up

The DataLink may power up in any of 3 ways; normal DC power, by the RTC (Real Time Clock) because a logging interval has expired, or by plugging the Carrier Transicold computer cable (P/N 22-01737-00) into the downloader port.

If the DataLink has awakened because the logging interval is up, the DataLink will log the appropriate data and power-off when it is through. It will continue to log data for the next hour (2 minute interval setting) or 8 hours (all other intervals). The DataLink will wake following a unit safety shut down or when the unit is switched off.

b. DataLink Diagnostics

The DataLink start up diagnostics processing will occur each time there is a power up or after a hardware reset. This processing will test the DataLink hardware for proper operation. If any critical test fails, then the fault LED will flash the test code three times to indicate what test failed. If any of these test fails, the module must be replaced.

Table 2-3 - DataLink Codes

CODE	TEST
1	Memory Test 1
2	Memory Test 2
3	Timer Test 1
4	Timer Test 2
5	Timer Test 3
6	Converter Test 1

c. Trip Start Processing

For the user to initiate a Trip Start: press the PRETRIP CHECK key on the control panel or use the DataLink Tool Box program to initiate Trip Start.

d. Additional Data Sensors

DataLink can have up to 5 thermistors, 1 fuel level sensor and 1 door open/closed switch.

2.6.4 Status LEDs

The DataLink contains four status LEDs. These are as follows:

- Fault/Alarm (Red)
- Battery Status (Yellow)
- Communication (Green)
- Status/Power/Executing Code (Yellow)

Fail - Fault/Alarm LED:

The Fault/Alarm LED indicates if a hardware fault or alarm has occurred in the DataLink. If a hardware fault occurs, the LED will flash the fault code three times, then the processor will reset. The fault codes and their code numbers are defined in Table 2-3. Fault codes will only be displayed on power up. If the DataLink powers up properly, then this LED will indicate an alarm condition that has been detected. The alarm LED should turn on when the alarm is detected, and off when the alarm goes away.

If an alarm occurs, then the LED will be on solid until the alarm goes away.

The out of range values are as follows:

Thermistor Inputs:
Low limit = -58.0°F (-50°C)
High limit = 158°F (70°C)

For sensor input alarms, the alarms can only be cleared by using DataLink Toolbox PC Program. See 2.6.6

Batt - Battery Status LED:

The Battery status LED pulses at a rate of 1 second on/1 second off when the battery voltage is greater than or equal to 6.0V. It will be on solid when the battery voltage is less than 6.0V but greater than or equal to 1.0V. It will be off when the battery voltage is less than 1.0V.

Comm - Communication LED:

The Communication LED will normally be off. Two to three blinks per minute indicates DataLink is communicating with micro. If the LED comes on steady for 5-6 seconds, there is no communications between DataLink and micro.

Stat - Status/Power LED:

The Status/Power LED indicates if the DataLink is powered up. The LED will be off when power is off or the DataLink is in a sleep mode running off the battery. The LED will pulse at a rate of 1 second on/1 second off.

2.6.5 Message Trip Comment

DataLink has the capability to allow the user to enter comments directly into DataLink. The comments have a maximum length of 78 characters. Only one comment can be recorded per day. In the event that multiple comments are entered, only the last will be saved.

2.6.6 DataLink Communications

a. DataLink Retrieval - Interrogation

Data retrieval from the DataLink can be accomplished with an IBM or Windows compatible computer connected using a Carrier Transicold Download cable P/N 22-01737-00 and software program.

The DataLink Toolbox software (DOS program) for a computer is supplied on a 3.5 inch floppy disk. This software allows downloading, screen view of the data, and printing.

The ReeferManager for Windows PC Software Program can also be used to download data.

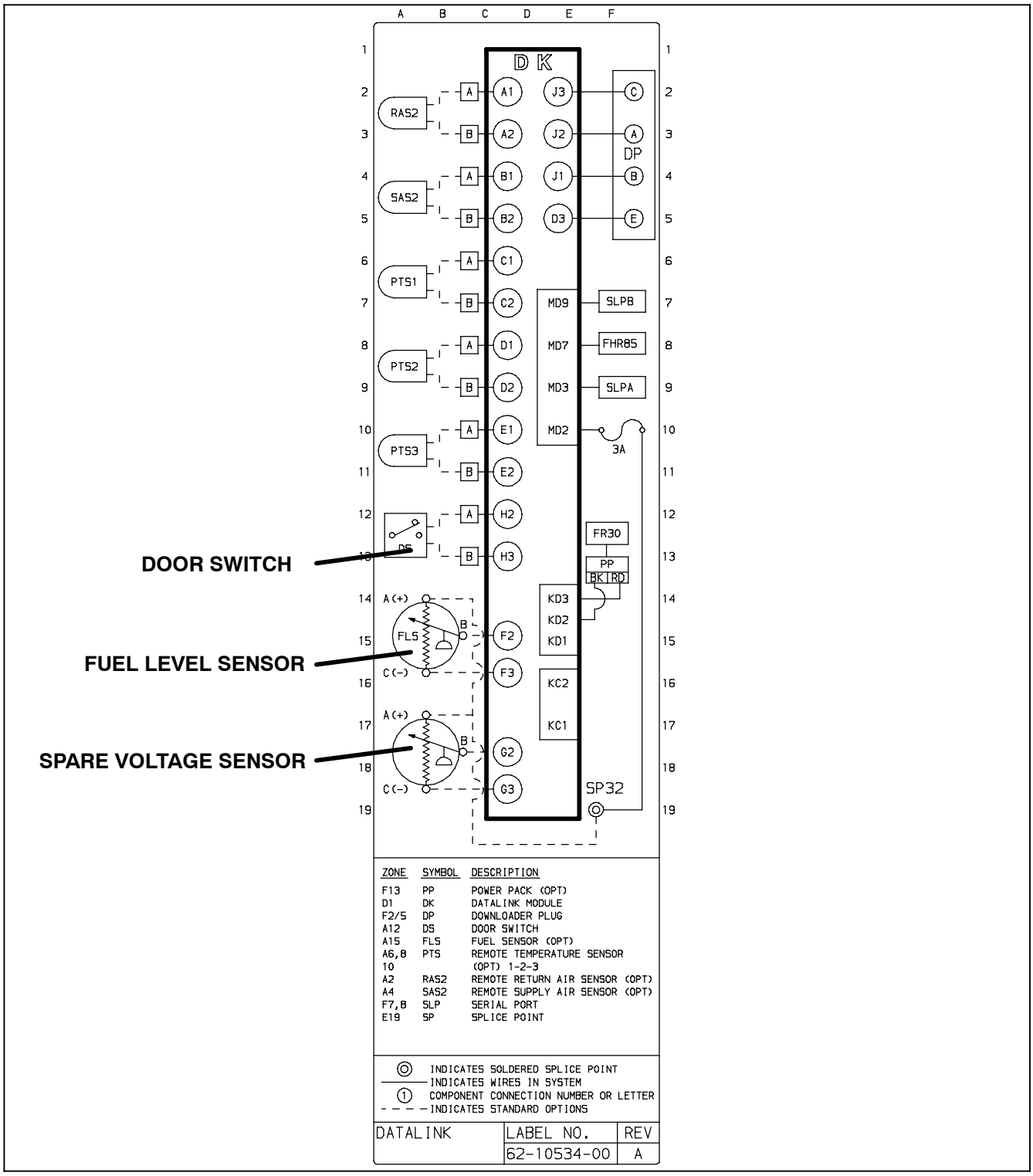


Figure 2-19. DataLink Electrical Schematic

2.7 REMOTE MONITORING - (Optional)

The microprocessor controller is equipped with a RS232 communication port. This port can be used to communicate unit operating data to a mobile satellite transmitter. This information will then be relayed back to the office via a modem to a computer.

There are presently three (3) protocols supported. The protocol for the QualComm transmitter, the protocol for the HUGHES transmitter, and Carrier Communication Protocol. The microprocessor will power up and transmit a HUGHES protocol packet and continue to transmit a packet every hour. The microprocessor will transmit in the Carrier, QualComm protocol if a data packet is requested.

2.8 ENGINE DATA

	ULTRA/EXTRA XT NDL--93N	EXTRA XT NDL--93E	X21800/2100 NDL-- 93S	X2 1800 NDL--93W
Engine Models	CT4-134DI (V2203EDI)	CT4-114TV (V1903)	V2203-DI ESC	V1903-IDI ESC
Displacement	(134 in^3) 2.2 liters	(114 in^3) 1.9 liters	134 in^3 (2.2 liters)	(114 in^3) 1.9 liters
No. Cylinders	4			
Weight	422 lbs (191.4 kg)		417.8 lbs (189.5 kg)	
Coolant Capacity	1.675 gallons (6.3 liters) (50/50 mix – never to exceed 60/40)			
Oil Capacity with Filter	15 quarts (14 liters)			
Fuel	Winter: Diesel No. 1 Summer: Diesel No. 2			
Glow Plug Amperage	7.5 amps per plug at 12 vdc (nominal)			

a. Lubrication System

Oil Pressure:

40 to 60 psig (2.7 to 4.1 Bar)
(Engine in high speed)

Oil Pressure Safety Switch Setting Closes:

15 ($\pm$ 3) psig (1.02 Bar)

Lube Oil Viscosity:

Outdoor Temperature		SAE
Fahrenheit	Centigrade	
Below 32°	0°C	10W or 15W40
32° to 77°F	0° to 25°C	20W or 15W40
Over 77°F	Over +25°C	30W or 15W40

Extended Service Interval (ESI) packages are standard on X Series units beginning with S/N JAB90602792. The ESI package reduces the frequency of scheduled service intervals. The two tables below reflect the differences between standard and ESI packages.

Oil Change Intervals - Standard Service Interval	
API Class CI or higher	MOBIL DELVAC
2000 Hours or 1 yr	4000 Hours or 1 yr

Oil Change Intervals - Extended Service Interval	
API Class CG or higher	MOBIL DELVAC
3000 Hours or 2 yr	4000 Hours or 2 yr

⚠ CAUTION

When changing oil filters, the new filters should be primed (partially filled) with clean oil if possible. If the filters are not primed, the engine may operate for a period with no oil supplied to the bearings.

NOTE

The maximum oil change interval is one year for CI oil or two years for Mobil Delvac unless units are equipped with Extended Service Interval Packages. The only approved synthetic lube oil is Mobil Delvac. The normal oil change intervals should be reduced if the equipment is operated under extreme conditions such as in dirty environments.

Refer to Section 6.1 for more detailed information on service intervals.

2.9 ENGINE SCREW THREADS

All threads used on the diesel engine are metric.

2.10 ENGINE AIR SYSTEM

The air cleaner is put on the engine to prolong its life and performance by preventing dirt and grit from getting into the engine causing excessive wear on all operating parts. However, it is the responsibility of the operator to give the air cleaner equipment regular and constant attention in accordance with the instructions. (Refer to Section 6.10.5)

Clean air is supplied to the engine through the air cleaner (Refer to Section 6.3.4). The air is necessary for complete combustion and scavenging of the exhaust gases. As the engine piston goes through the intake stroke, the piston draws clean fresh air down into the cylinder for the compression and power strokes. As the engine goes through its exhaust stroke, the upward movement of the piston forces the hot exhaust gases out of the cylinders through the exhaust valves and the exhaust manifold. If the air filter is allowed to become dirty, the operation of the engine would be impaired.

2.11 COMPRESSOR DATA

Compressor Models	**05G - 37/41cfm**
No. Cylinders	6
No. Unloaders	2
Weight	137 lbs (62 kg)
Oil Charge	6.0 pints (2.8 L)

APPROVED COMPRESSOR OIL	
Refrigerant	**05G**
R-404A	Mobil Arctic EAL 68

2.12 REFRIGERATION SYSTEM DATA

Defrost Air Switch (DAS) Initiates Defrost:	1.40 (± .07) inch (35 ± 1.8 mm) WG
Defrost Termination Temp. (DTT) **– LOWER FOR OLDER UNITS, UPPER AND LOWER FOR X2**	Opens: 55 ± 5°F (12.8± 2.8°C) Closes: 40 ± 7°F (4.4 ± 3.9°C)
Defrost Termination Temp. (DTT) **– UPPER OLDER UNITS ONLY**	Opens: 45 ± 5°F (7.2± 2.8°C) Closes: 30 ± 7°F (–1.1 ± 3.9°C)
Expansion Valve Superheat Setting at 0°F (–17.8°C) box temperature:	Setting: 8 to 10°F (4.4 to 5.6°C)
Expansion Valve MOP	55 psig (3.74 Bar) Ultra 60 psig (4.08 Bar) Extra
Fan Clutch Air Gap	0.015 to 0.150″ (0.38 to 3.8mm)
Fusible Plug Setting	208° to 220°F (97.8° to 104.4°C)
High Pressure Switch (HP1)	**Cutout:** 465 ± 10 psig (31.6 ± 0.68 Bar) **Cut-in:** 350 ± 10 psig (23.8 ± 0.68 Bar)
Head Pressure Control Switch (HP2)	**Cutout:** 300 ± 10 psig (20.4 ±0.68 Bar) **Cut-in:** 200 ± 10 psig (13.6 ± 0.68 Bar)
Refrigeration Charge	Refer to Table 2-1
Gearbox Oil	Mobil SHC 75–90W: 15oz (0.44 liters)
Fanshaft Oil	Mobil SHC 630: 3.2oz (0.09 liters)
Unit Weight (Approximate)	1600 lb. (725 kg)

2.13 SAFETY DEVICES

System components are protected from damage caused by unsafe operating conditions by automatically shutting down the unit when such conditions occur. This is accomplished by the safety devices listed in Table 2-4.

Table 2-4. Safety Devices

Unit Shutdown Safety Devices		
Unsafe Conditions	**Safety Device**	**Device Setting**
Low engine lubricating oil pressure	Oil pressure safety switch (OP) (microprocessor reset)	Opens below 15 ± 3 psig (1.02 ± 0.2 Bar)
High engine cooling water temperature	Water temperature sensor (WTS) (microprocessor reset)	Refer to Section 3.10 AL1 – ENG HOT
Excessive current draw by glow plug circuit, control circuit or starter solenoid (SS)	Fuse (F1)	Opens at 80 amps
Excessive current draw by fuel heater (optional)	Fuse (F2)	Opens at 20 amps
Excessive current draw by speed relay and front unloader	Fuse (F4)	Opens at 15 amps
Excessive current draw by auto restart or out-of-range lights	Fuse (F5)	Opens at 7 1/2 amps
Excessive current draw by fault light	Fuse (F6)	Opens at 5 amps
Excessive current draw by microprocessor	Fuse (F9)	Opens at 5 amps
Excessive current draw by fuel solenoid, clutch or defrost light	Fuse (F11)	Opens at 10 amps
Excessive current draw by SV1, SV2, SV4, heat light, cool light or rear unloader	Fuse (F12)	Opens at 10 amps
Other Safety Devices		
Unsafe Conditions	**Safety Device**	**Device Setting**
Excessive compressor discharge pressure	High pressure cutout switch (HP-1) automatic reset	Refer to Section 2.12
Excessive compressor discharge temperature	Compressor discharge temperature sensor (CDT) (microprocessor reset)	Refer to Section 3.10 Compressor Discharge Temperature Alarm

2.14 COMPONENT RESISTANCE & CURRENT DRAW

Table 2-5. Component Resistance & Current Draw

Component	Ohms	Amps
SV1	7.8 ± 0.3 Ohms	0.10 to 2.0 Amps
SV2 & 4	10.6 ± 0.3 Ohms	0.75 to 2.0 Amps
WTS	670 to 690 Ohms at 100°C ±0.5°C	
Unloader	10.6 ± 0.3 Ohms	1.0 to 2.0 Amps
Clutch	2.5 ± 0.2 Ohms	3.0 to 5.0 Amps
Speed solenoid	1.5 to 2.5 Ohms	3.0 – 8.0 Amps
Fuel solenoid Red–Black wires:	11.1 Ohms to 13.4 Ohms	0.25 to 2.0 Amps
White–Black wires: Can not be accurately measured with Coil Commander in circuit.		30.0 to 40.0 Amps
Indicator lights	4.8 ± 0.2 Ohms	NA
Unit non-running amps		6–9 Amps
Glow Plug Amps Each Plug SEE ENGINE DATA		6 - 9 Amps
Glow Plug Total Circuit		4–36 Amps
Starter Amps	NA	270 – 380 amps

2.15 REFRIGERANT CIRCUIT DURING COOLING (See Figure 2-20)

When cooling, the unit operates as a vapor compression refrigeration system. The main components of the system are the (1) reciprocating compressor, (2) air-cooled condenser, (3) expansion valve, and (4) direct expansion evaporator.

The compressor raises the pressure and the temperature of the refrigerant and forces it into the condenser tubes. The condenser fan circulates surrounding air over the outside of the condenser tubes. The tubes have fins designed to improve the transfer of heat from the refrigerant gas to the air. This removal of heat causes the refrigerant to liquefy; thus liquid refrigerant leaves the condenser and flows through the solenoid valve SV-1 (normally open) and to the receiver.

The receiver stores the additional charge necessary for low ambient operation and for the heating and defrost modes. The receiver is equipped with a fusible plug which melts if the refrigerant temperature is abnormally high and releases the refrigerant charge.

The refrigerant leaves the receiver and flows through the receiver outlet shutoff valve (King valve). The refrigerant then flows through the subcooler. The subcooler occupies a portion of the main condensing coil surface and gives off further heat to the passing air.

The refrigerant then flows through a filter-drier where an absorbent keeps the refrigerant clean and dry; and the electrically controlled liquid line solenoid valve (SV-2, normally closed) which starts or stops the flow of liquid refrigerant.

The refrigerant flows to the “Liquid/suction” heat exchanger. Here the liquid is further reduced in temperature by giving off some of its heat to the suction gas.

The liquid then flows to an externally equalized thermostatic expansion valve which reduces the pressure of the liquid and meters the flow of liquid refrigerant to the evaporator to obtain maximum use of the evaporator heat transfer surface.

The refrigerant pressure drop caused by the expansion valve is accompanied by a drop in temperature; thus, the low pressure, low temperature fluid that flows into the evaporator tubes is colder than the air that is circulated over the evaporator tubes by the evaporator fan. The evaporator tubes have aluminum fins to increase heat transfer; therefore heat is removed from the air circulated over the evaporator. This cold air is circulated throughout the trailer to maintain the cargo at the desired temperature.

The transfer of heat from the air to the low temperature liquid refrigerant causes the liquid to vaporize.

This low temperature, low pressure vapor passes through the “suction line/liquid line” heat exchanger where it absorbs more heat from the high pressure/high temperature liquid and then returns to the compressor.

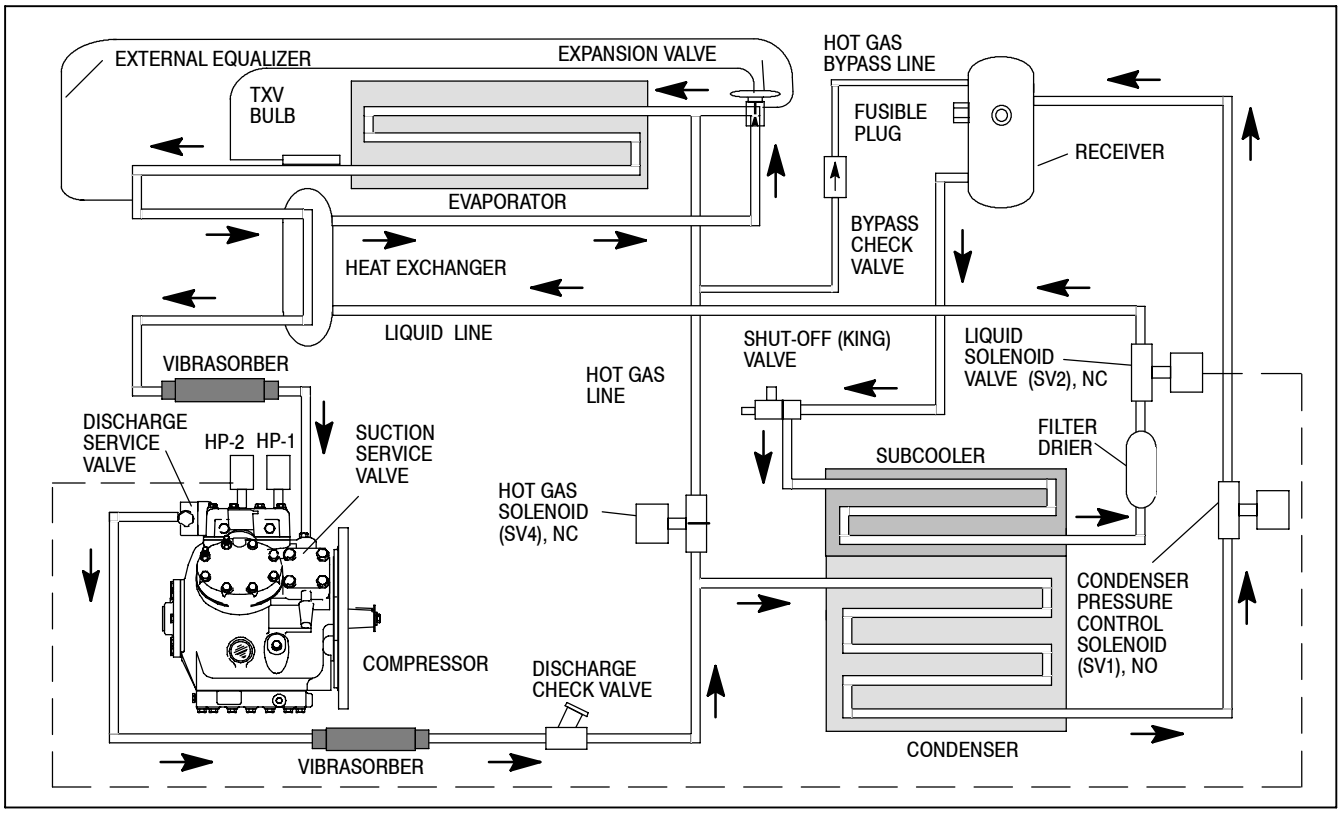


Figure 2-20. R-404A Refrigerant Circuit - Cooling

2.16 REFRIGERANT CIRCUIT - HEATING AND DEFROSTING (See Figure 2-21)

For units with UltraFreeze Refer to Section 4.4.

For units without UltraFreeze the unit will only heat when the controller is set above +10°F (-12.2°C) as the heat relays are electronically locked out with set points below +10°F (-12.2°C). Heat lockout can be overridden by setting CNF4 to "ON".

When vapor refrigerant is compressed to a high pressure and temperature in a reciprocating compressor, the mechanical energy necessary to operate the compressor is transferred to the gas as it is being compressed. This energy is referred to as the "heat of compression" and is used as the source of heat during the heating cycle.

2.16.1 Heating and Defrost

NOTE

Solenoid valve (SV-2) remains open during heating or defrosting to allow additional refrigerant to be metered into the hot gas cycle (through the expansion valve) providing additional heating capacity until de-energized by head pressure control switch HP-2.

When the controller calls for heating, hot gas solenoid valve (SV-4) opens and the condenser pressure control solenoid valve (SV-1) closes. The condenser coil then fills with refrigerant, and hot gas from the compressor enters the evaporator. Also the liquid line solenoid valve (SV-2) will remain energized (valve open) as the head pressure control switch (HP-2) will remain closed until the compressor discharge pressure increases to cut-out setting (Refer to Section 2.12), at which time switch HP-2 opens to de-energize the liquid line solenoid valve (SV-2) and the valve closes to stop the flow of refrigerant to the expansion valve.

When the compressor discharge pressure falls to cut-in setting (Refer to Section 2.12), pressure switch (HP-2) closes and in turn energizes the normally closed liquid solenoid valve (SV-2) which opens, allowing refrigerant from the receiver to enter the evaporator through the expansion valve. The function of the hot gas bypass line is to raise the receiver pressure when the ambient temperature is low (below 0°F = -17.8°C) so that refrigerant flows from the receiver to the evaporator when needed.

Defrost Mode only: 90 seconds after entering defrost, suction pressure is monitored. If suction pressure rises higher than 57 psig (3.9 Bar), SV1 is opened for 1 second to reduce suction & discharge pressure, and the suction pressure is monitored again after 30 seconds. Defrost will continue and does not terminate until the defrost termination thermostat(s) (DTT) reach termination temperature and open, or the compressor discharge temperature (CDT) reaches 310° F (154.4°C) for 1 minute (2 minutes after defrost initiation. At defrost termination, SV1 is first opened, then SV4 is closed, and the unit shifts to low speed to engage the fan clutch. The unit then exits the defrost cycle, and resumes normal operation.

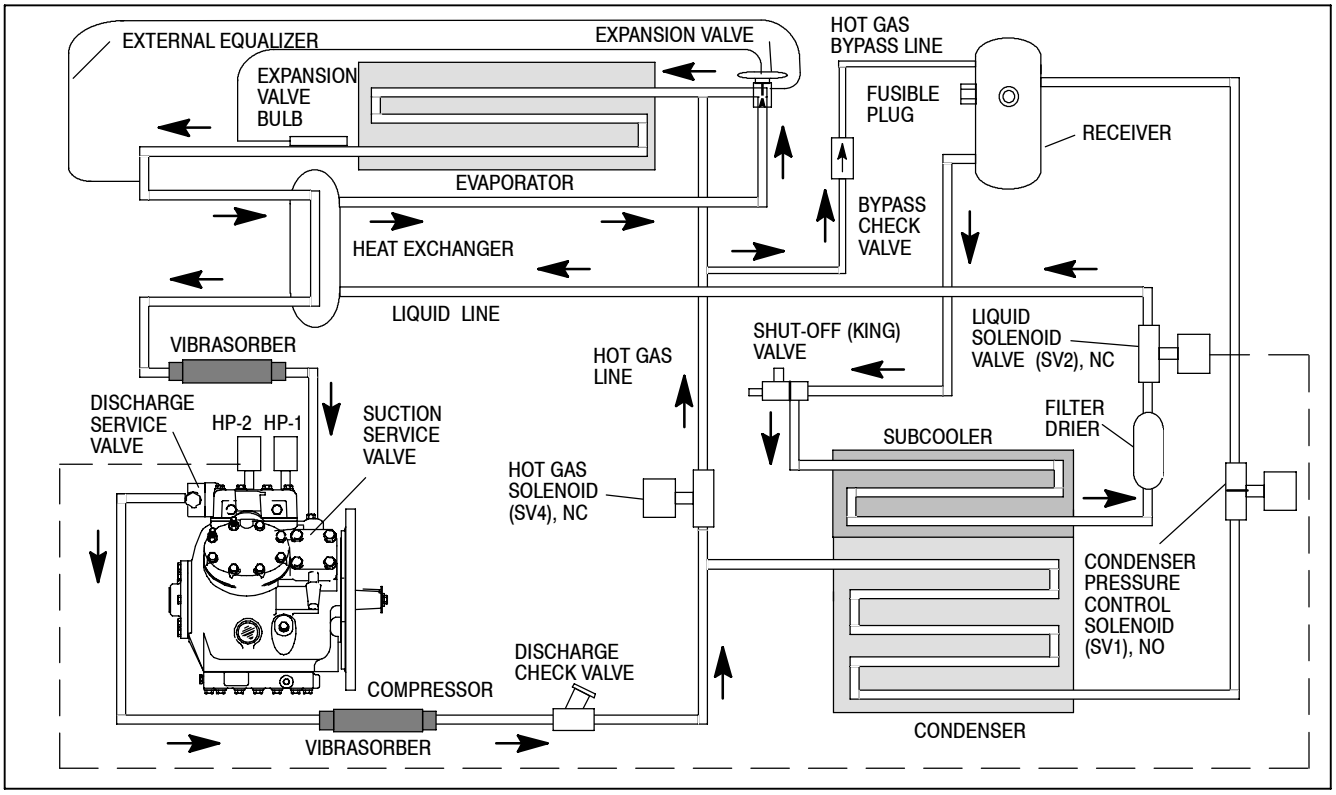
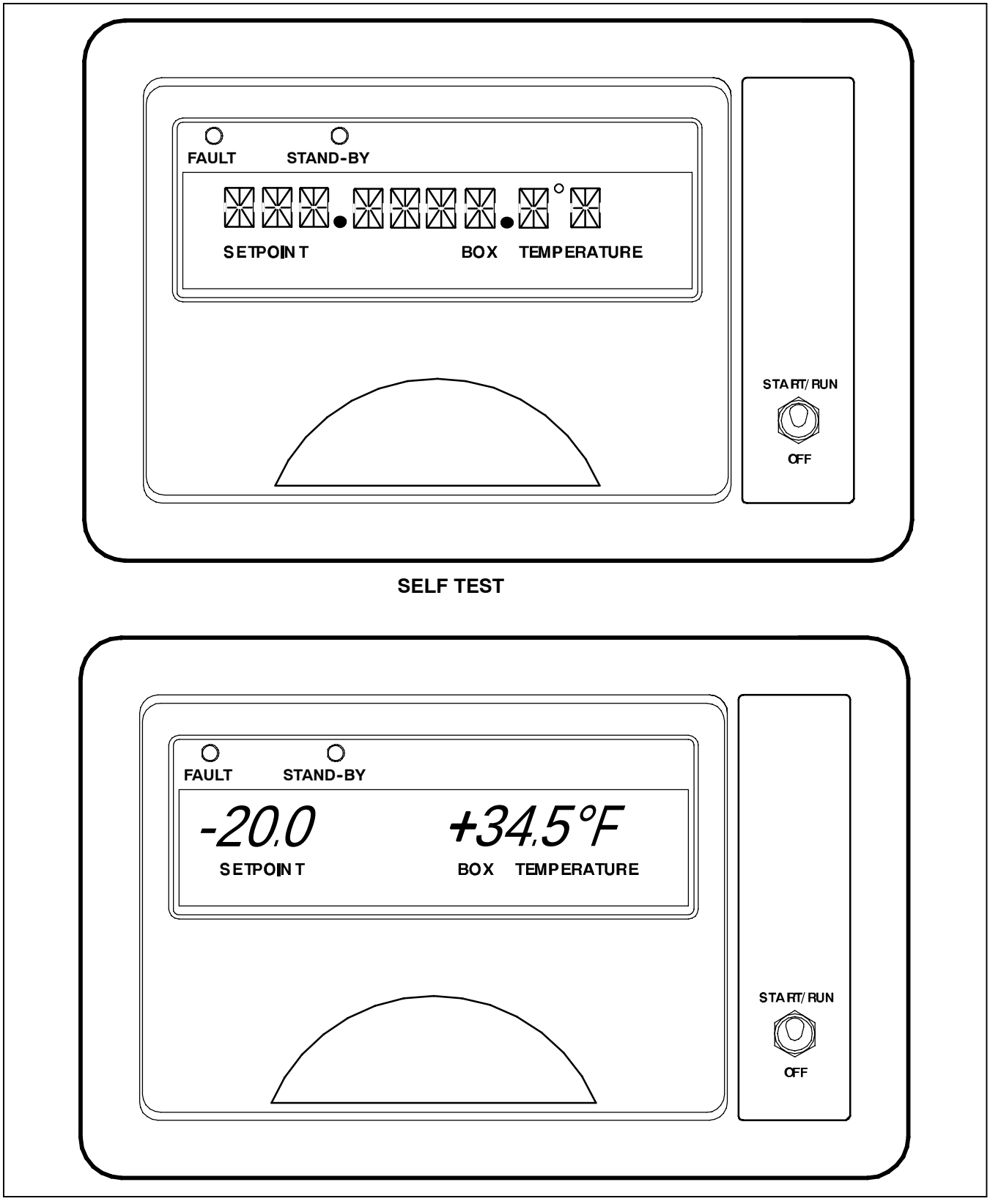


Figure 2-21. R-404A Refrigerant Circuit - Heating and Defrosting

SECTION 3 - OPERATION

3.1 STARTING UNIT - AUTO



⚠ WARNING

Under no circumstances should ether or any other starting aids be used to start engine.

NOTES

1. Whenever starting the engine, in order to reduce starter cranking and engine loads, the microprocessor starts and operates in low speed, unloaded cool for the first 15 seconds. After the first 15 seconds the microprocessor will allow the unit to operate normally.
2. The unit will remain in low speed for 5 minutes after engine start-up when: Auto Start/Stop is at any setpoint or Continuous Run setpoint is below 10°F (-12°C).

Place the Start/Run-Off switch in the Start/Run position.

The microprocessor controller will run a self test. All of the mode lights will light, all of the segments on the display will be turned on.

The display will then show the setpoint temperature on the left and the box temperature of the trailer on the right. The last character (after the degree symbol) shows the temperature units as F (Fahrenheit) or C (Celsius).

If the unit is in Auto Start/Stop mode or Continuous Run/Auto Operation mode the glow plugs will energize.

The length of time of glow cycle depends on engine temperature. (See 4.1.5) The buzzer on units so equipped will sound for 5 seconds, and the diesel engine will start.

If the unit is set for Continuous Run/Manual Operation mode, the unit must be started manually.

The microprocessor controller monitors box temperature, battery voltage, and engine coolant temperature. Once the setpoint is reached the controller will shut off the diesel engine to conserve fuel. The controller will not shut off the engine if the battery voltage is not sufficient to restart it.

The controller will restart the engine if any of the following criteria have been met:

•Box temperature has moved away from setpoint by ± 11°F (± 6.1°C)for setpoints in the perishable range and +11° F (+6.1°C) for setpoints in the frozen range **DURING** minimum off time.

•Box temperature has moved away from setpoint by ±(3.6°F (2.0°C) **AFTER** minimum off time for setpoints in the perishable range or +0.5°F (0.3°C) for setpoints in the frozen range.

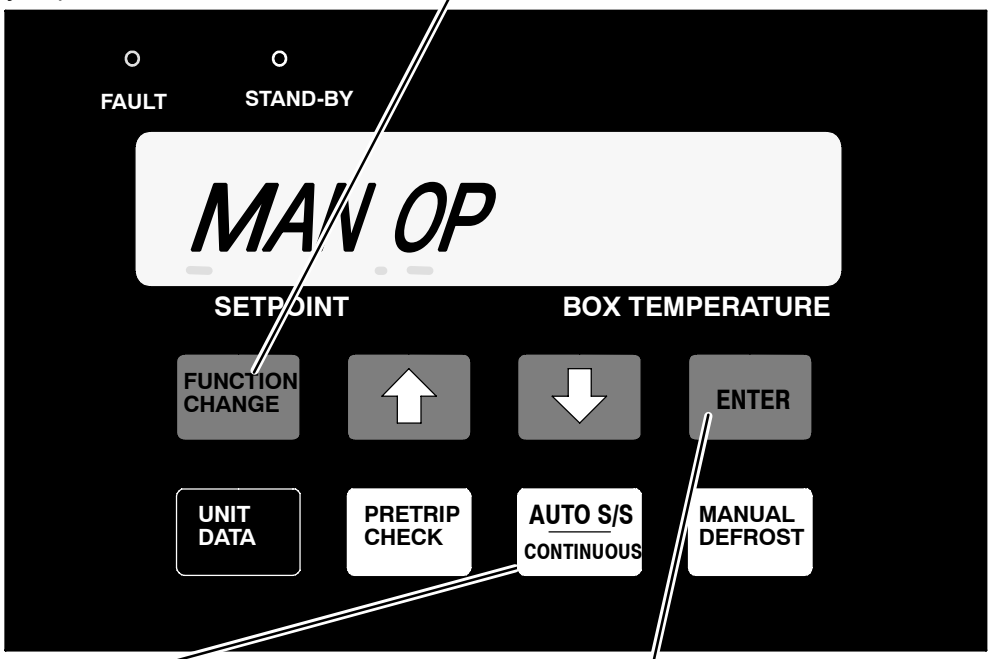
•The battery voltage drops below 11 VDC (12.2 VDC for units with EEPROM Rev 3.25 and higher - Refer to Section 3.9.1 for unit data)

•The engine coolant temperature drops below 34°F (1°C).

3.2 MANUAL START – GLOW AND CRANK – IF EQUIPPED*

1. Place START/RUN - OFF switch to the START/RUN position. If START/STOP is displayed, press AUTO S/S-CONTINUOUS toggle key to place unit in Continuous Run Mode .

2. Press FUNCTION CHANGE key until AUTO OP or MAN OP is displayed. If MAN OP appears, unit is in manual start mode.

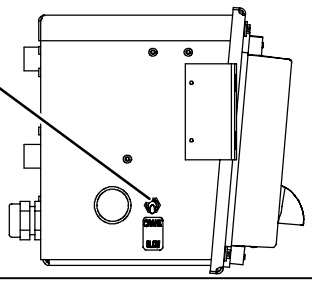


3. If AUTO OP appears, first press ENTER key, then UP or DOWN arrow key until MAN OP is displayed. Press ENTER key to lock in manual mode.

4. Hold GLOW/CRANK switch in the GLOW position for 5 to 15 seconds (see chart on next page). Then hold the GLOW/CRANK switch in the CRANK position for up to 10 seconds to start the diesel engine.

5. With MAN OP selected, press AUTO S/S-CONTINUOUS key to toggle between Auto Start-Stop and Manual Start/Continuous Run modes.

Side of Control Box



***NOTE**

The GLOW/CRANK switch was removed from units built beginning in March, 2007. Units without the GCS have serial numbers beginning with LAF.

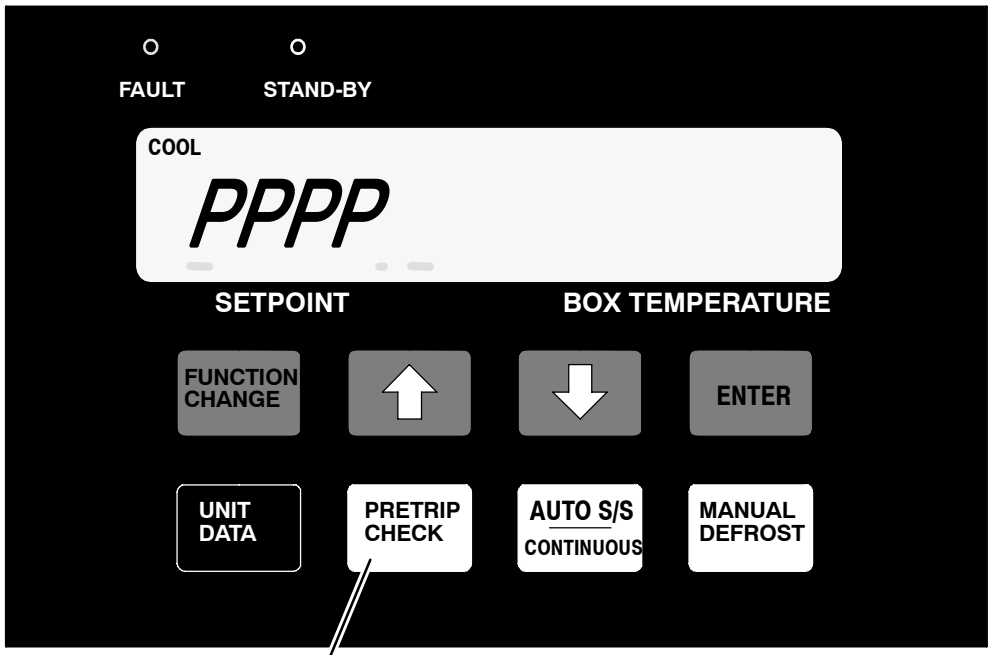
NOTE

Refer to Section 4.1.5 for glow times.

⚠ WARNING

Under no circumstances should ether or any other starting aids be used to start engine.

3.3 PRETRIP



1. Start and run unit until box temperature is 40°F (4.4°C) or lower.

2. Press PRETRIP CHECK key to start PRETRIP. "PPPP" will appear on the display.

The PRETRIP mode is for checking unit operation and evaluating operation of all modes and indicating a failure when detected. The following details the sequence :

a. Unit operating and box temperature is below 40°F (4.4°C).

b. Operator presses the PRETRIP key. If the defrost thermostat (DTT) is closed, the controller will display "PPPP." If DTT is open, no response – end of test.

c. Controller displays "PPPP" Pre-trip mode is started.

d. After 30 seconds in high speed cool, unit cycles to low speed loaded cool.

e. After 30 seconds, unit cycles to low speed unloaded cool.

f. After 30 seconds, unit cycles to low speed unloaded heat.

g. After 30 seconds, unit cycles to low speed loaded heat.

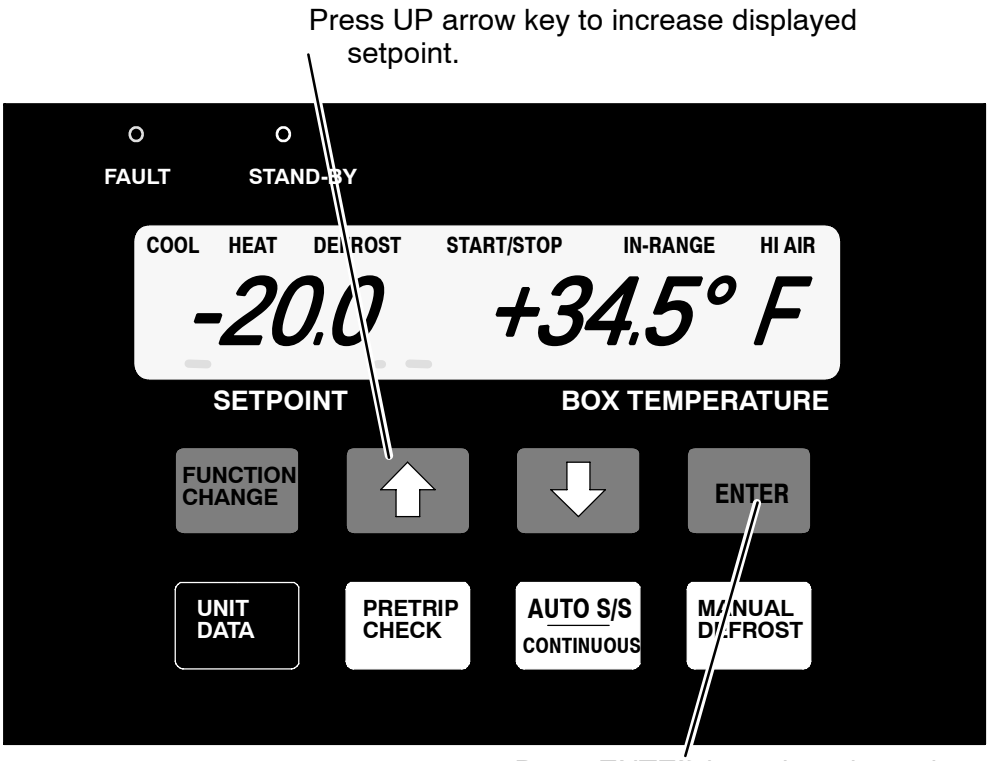
h. After 30 seconds, unit cycles to high speed heat and displays coolant temperature.

i. After 30 seconds, unit cycles to high speed cool and displays defrost interval selected for 30 seconds, then unit cycles to defrost if DTT is closed.

j. After standard defrost cycle, Pretrip is terminated and unit returns to normal operation.

This is not a self-diagnosing pretrip test. No specific pretrip alarms will be generated. Pretrip must be monitored by the user to verify that the unit operates through all cycles.

3.4 CHANGING SETPOINT



Setpoints of –22°F to +86°F (–30°C to +30°C) may be entered via keypad. The controller always retains the last entered setpoint in memory. If no setpoint is in memory (i.e. on initial startup), the controller will lock out the run relay and flash "SP" on the left hand display until a valid setpoint is entered.

NOTE

The microprocessor Configurations allow a minimum and maximum setpoint to be entered, so that only setpoints within that range may be selected. Refer to Section 6.32 for more detailed information on selecting configurations.

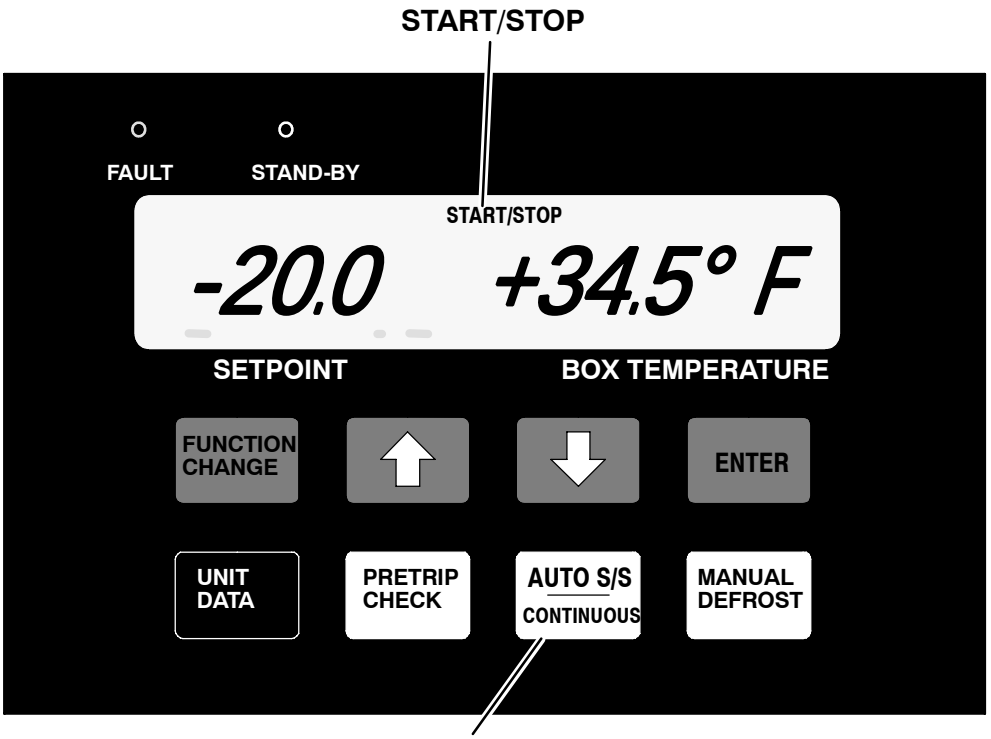
The setpoint may be changed up or down in whole numbers until the desired setpoint is displayed. The display will flash to indicate that the setpoint reading being displayed is a non-entered value. Each time the UP/DOWN Arrow key is pressed, the 5 second display timer will be reset.

Pressing the ENTER key will cause the new displayed setpoint value to become active. If the display is flashing and the new value is not entered, after 5 seconds of no keyboard activity, the display will revert back to the active setpoint.

NOTE

Beginning with software Rev. 3.29 changing setpoint from the keypad can be locked out by setting CNF23 to ON. Refer to Section 6.32.

3.5 START–STOP OPERATION



1. Press the AUTO S/S-CONTINUOUS toggle key until START-STOP is displayed. Unit is now in Automatic Start/Stop mode.

Automatic start/stop is provided to permit starting/restarting of the diesel-driven compressor as required. This gives the microprocessor automatic control of starting and stopping the diesel engine. The main function of automatic start-stop is to turn off the refrigeration system near the setpoint to provide a fuel efficient temperature control system and then restart the engine when needed. Start-Stop operation is normally used for frozen loads.

The unit will remain in low speed for 5 minutes after engine start-up. (10 minutes for units with EEPROM prior to Rev. 3.24) If the unit fails to start, shuts down on a safety, or fails to run for the minimum run time, three consecutive times, the fault light will come on.

Low speed Start–up for low coolant temperatures is available on Configuration 7 (Refer to Table 6-1) for all units starting with EEPROM REV 3.25. Refer to Section 3.9.1 for unit data.

The microprocessor controller monitors box temperature, battery voltage, and engine coolant temperature

Whenever the unit starts in Start–Stop, it will run until:

•It has run for the predetermined minimum run time.

•The engine coolant temperature is above 122°F (50°C)

•The box temperature is at setpoint.

The controller will not shut off the engine if the battery voltage is not sufficient to restart it. Battery voltage above approximately 13.4 volts is required for shutdown. This varies depending on ambient. Look at battery voltage in data list to find out whether shutdown voltage has been reached. If there is a "+" in front of the number, the voltage is enough to shutdown and restart. If only the number appears, the voltage is still too low for shutdown.

The controller will restart the engine if any of the following criteria have been met:

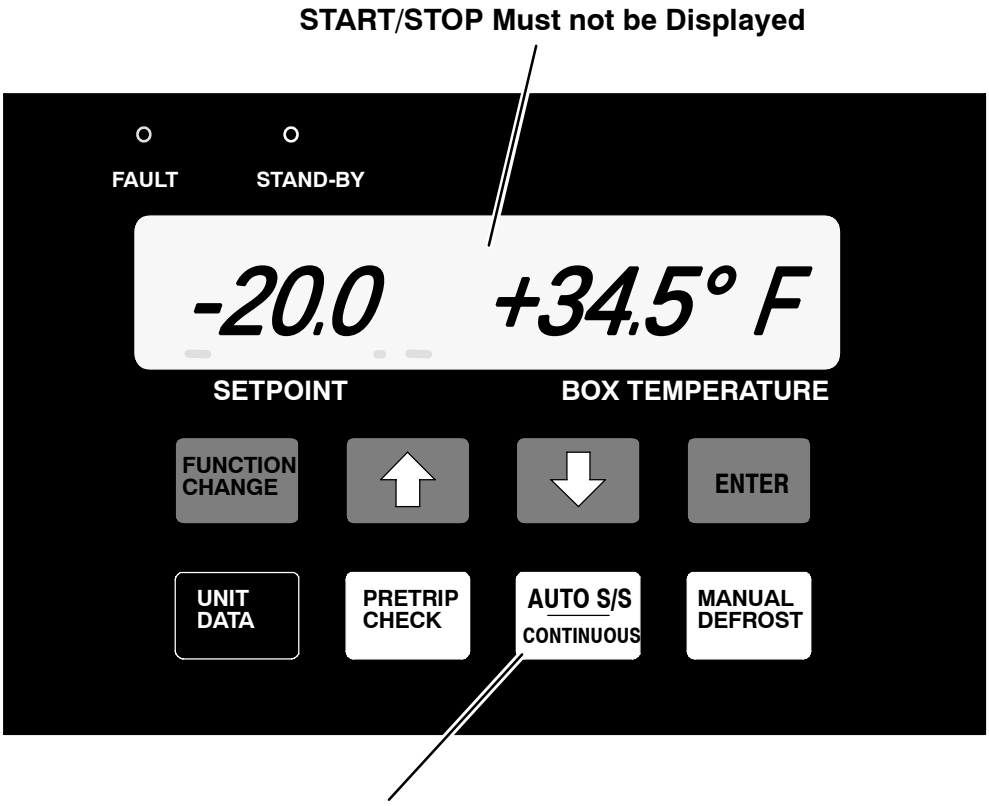
•Box temperature has moved away from setpoint by ± 11°F (± 6.1°C)for setpoints in the perishable range and +11° F (+6.1°C) for setpoints in the frozen range **DURING** minimum off time.

•Box temperature has moved away from setpoint by ±(0.5°F (0.3°C) **AFTER** minimum off time for setpoints in the perishable range or +0.5°F (0.3°C) for setpoints in the frozen range.

•The battery voltage drops below 11 Vdc (12.2 VDC for units with EEPROM Rev 3.25 and higher – Refer to Section 3.9.1 for unit data)

•The engine coolant temperature drops below 34°F (1°C).

3.6 CONTINUOUS RUN OPERATION



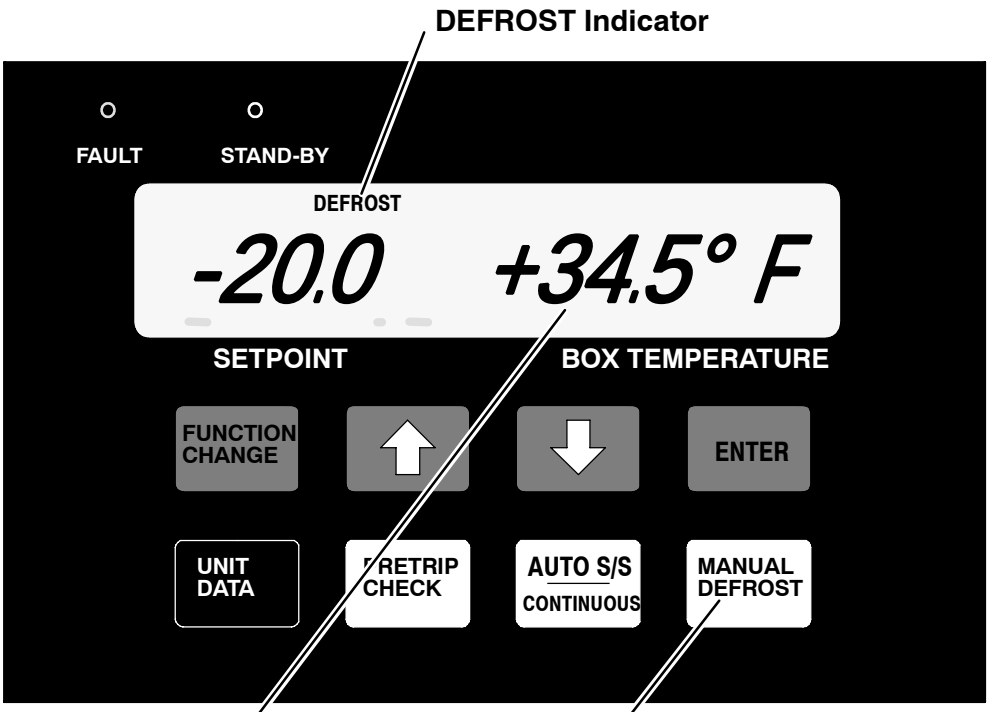
1. Check if START-STOP is displayed. If it is, press the AUTO S/S-CONTINUOUS toggle key to place unit in Continuous Run mode.

In the Continuous Run mode, the diesel engine will run continuously providing constant air flow and temperature control to the product. The engine will not be allowed to shut off except for safeties if the engine stalls. Continuous Run operation is normally used for perishable loads.

Start-Stop and Continuous operation may be tied to the setpoint ranges for frozen and perishable loads and the START-STOP/CONTINUOUS key may be locked out using CNF3 and CNF11. Refer to Section 6.32.

The unit will remain in low speed for 5 minutes after engine start-up when the Continuous Run setpoint is below 10°F (-12°C).

3.7 MANUAL DEFROST



1. Check that box temperature is 40°F (4.4°C) or lower.

2. Press the MANUAL DEFROST key to initiate Manual Defrost.

NOTE

Defrost cannot be started when the Evaporator Coil temperature is above 40°F (4.4°C).

The defrost mode may be initiated in three different ways if the evaporator coil is below 40°F (4.4°C):

1. Defrost is initiated automatically at preset intervals by the defrost timer in the microprocessor.
2. Defrost is initiated by the defrost air switch.
3. The defrost mode may be manually initiated by pressing the Manual Defrost Key.

The defrost mode terminates when the evaporator temperature is higher than 55°F (12.8°C). Should the defrost cycle not complete within 45 minutes, the defrost cycle is terminated.

After the 45 minute termination, the controller will wait 1.5 hours before attempting another defrost cycle. Pressing the manual defrost key will override this mode and start a defrost cycle.

If a shutdown alarm occurs, defrost will be terminated.

3.7.1 Automatic Defrost

The defrost mode may be automatically initiated by either of the following two devices when the evaporator coil temperature (DTT2) is below 40°F (4.4°C):

a. Defrost Interval Timer

The defrost interval for the Defrost Timer is set in the Functional Parameter List. Refer to Section 3.8.1.

When a Defrost Cycle is initiated by any method, the timer is reset to zero, and will not begin counting until the defrost cycle has terminated.

When the Start/Run–Off Switch is in the off position, the defrost timer will be reset to zero.

b. Defrost Air Differential Switch

The Defrost Air Differential Switch measures the difference in air pressure entering the evaporator against the pressure of the air leaving the evaporator. A build up of ice will cause the difference to increase. Once the pressure difference increases to the setting of the switch, the contacts will go closed, and initiate a defrost cycle, providing that the evaporator coil temperature is at or below 40°F (4.4°C).

The Defrost Timer is reset to zero whenever a defrost cycle ends (regardless of how it was initiated), and begins counting down until the next defrost cycle.

Total defrost cycle time is monitored by the microprocessor. Once the unit has been in a defrost cycle for 45 minutes, this timer will terminate the defrost cycle, and allow the unit to heat or cool as needed to maintain temperature control.

Should the defrost cycle not complete within 45 minutes or if the external defrost signal does not clear at defrost termination, the defrost cycle shall be terminated. The internal timer will reset for 1.5 hours and the external defrost signal will be ignored for defrost initiation. The manual defrost switch will override this mode and start a new 45–minute cycle. When defrost override is active, the appropriate alarm will be indicated. If the run relay is de–energized during defrost, defrost will be terminated.

TIP

The Manual Defrost Key can be used at any time to start a Defrost Cycle.

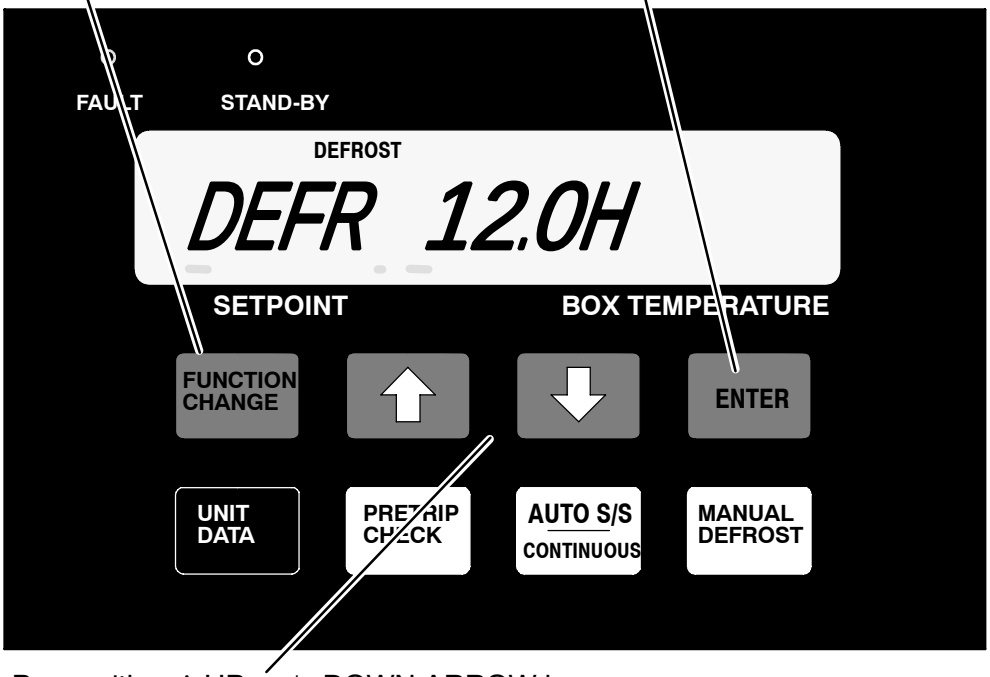
NOTE

Refer to Section 4.2.2 for more detailed information on Automatic Defrost.

3.8 FUNCTIONAL PARAMETERS

1. Press FUNCTION CHANGE key until Function to be changed is displayed.

2. Press ENTER key.



3. Press either ↑ UP or ↓ DOWN ARROW key until desired Function setting is displayed.

NOTE: *Function changes will change operation of unit.*

4. Press the ENTER key to lock in new setting.

NOTE

The ability to change functional parameters from the keypad can be locked out using CNF11. Refer to Section 6.32 for more detailed information.

The functional parameters will control selected operating features of the unit. These parameters can be displayed by pressing the FUNCTION CHANGE key. All functional parameters are retained in memory. The following sections describe the list of functions which can be modified via the keypad. A description of the function will be displayed on the left side with the corresponding data on the right side. The function parameter list can be scrolled through by pressing the FUNCTION CHANGE key or by using the UP/DOWN Arrow keys. With each FUNCTION CHANGE key push, the list will be advanced one. If the function key is pressed and held for one second, the list will be advanced one item at a time. This list will be circular, meaning once the end of the list is reached the list will go to the first entry. While the functional parameter is displayed, the data can be changed by pressing ENTER then pressing either the UP or DOWN Arrow keys. If the value is changed, the displayed data will then flash to indicate that the value has not been entered. If the new value is not entered in 5 seconds, the display will revert back to the last entered value. If the ENTER key is pressed, the display will stop flashing to indicate that the value has been entered. The new value will continue to be display for 5 seconds before reverting back to the default display. Each time a key is pressed, the 5 second delay will be reset. To select a different functional parameter the FUNCTION CHANGE key must be pressed first.

3.8.1 FUNCTIONAL PARAMETERS

The following table has columns for Code and English displays. English is the default setting. Change Functional Parameter to Code to see Code display format.

Table 3-1. Function Codes

CODE	ENGLISH	DATA
FN0	DEFR	Defrost Time Interval
FN1 ON	HIGH AIR	High Air Flow
FN1 OFF	NORM AIR	Normal Air Flow
FN2	OFF T	Start–Stop Minimum Off-time
FN3	ON T	Start–Stop Minimum On-time
FN4 A	REM PROBE	Controlling Probe - Return Air
FN4 B	SUP PROBE	Dual Controlling Probe - Return and Supply Air
FN5	Degrees F or C	Temperature Unit Displayed in °C or °F
FN6 ON	TIME STRT	Maximum Off-Time 30 Min
FN6 OFF	TEMP STRT	Temperature and Minimum Off-Time Based Restarting For AutoStart/-Stop
FN7	MOP STD	Unloader Control
FN10 ON	AUTO OP	Auto Start Operation
FN10 0FF	MAN OP	Manual Start Operation (On units equipped with Manual Glow/Crank Switch)
FN11	T RANGE	Out-of-Range Tolerance
Code vs English – Code vs. English display format		
Manual Glow Override – Normal or add 30 sec		
Alarm Reset – Alarm reset or no alarms		

Code Vs English Messages

The description for messages of the functional parameters, unit status and alarms can be displayed in English or Codes through this function selection. The two choices will be displayed as, ENGLISH or CODES. With this parameter set to CODES, all display descriptions will be set to their code display. This parameter will not change due to this selection. Refer to each section for the alternate display description.

Manual Glow Override

The auto start glow time can be manually overridden through this function. The messages is displayed as NORM GLOW or ADD GLOW. If the ADD GLOW selection is entered, the control will add 30 seconds of glow to the glow times listed in section 3.2. This feature must be selected before the 3 start attempts have been completed. At higher ambients, this override will only affect the second or third start attempt. The add glow time is deselected when the engine starts or fails to start. This parameter will not change due to the Code vs English selection.

Defrost Interval

The defrost interval is displayed with the description DEFR or FN0. The data for the interval will be displayed with one decimal place and then the capital letter H for hours (i.e. DEFR 12.0H). The defrost intervals are 1.5, 3, 6 or 12 hours.

Airflow

The status of the speed control solenoid override is displayed as HIGH AIR or NORM AIR. The code display is FN1. The high air setting is “ON” and the NORM AIR setting is “OFF.” If the display shows HIGH AIR, the unit is locked into high speed.

Off-Time

The off-time selection for the auto start mode is displayed with the description OFF T or FN2. The off-times are 10, 20, 30, 45 or 90 minutes. The data for the off-time will be displayed with two digits and then the capital letter M for minutes (i.e. OFF T 20M).

On-Time

The on-time selection for the auto start mode is displayed with the description ON T or FN3. The on-time is 4 or 7 minutes. The data for the on-time will be displayed with two digits and then the capital letter M for minutes (i.e. ON T 4M).

Controlling Probe

The number of controlling probes is displayed with the following abbreviations: REM PROBE selects the return air sensor as the controlling probe. SUP PROBE sets the supply air probe for all setpoints above +11°. For setpoints of +10° or below, the unit will always control on return air regardless of selection. The code display is FN4. The 1-probe setting is “A” and the 2-probe setting is “B.”

Standard Units Select

The standard unit selects how all parameters are displayed. The two choices are DEGREES F and DEGREES C. This parameter also controls whether pressure data is displayed in psig or bars (i.e. Degrees F or Degrees C). The code display is FN5. The selections are “F” or “C.”

Maximum Off Time

The descriptions for the maximum off time are TEMP STRT OR TIME STRT. The code display is FN6 and the selections are “ON” or “OFF.” “ON” corresponds to TIME STRT. With the unit in time start, the control will force the engine to restart 30 minutes after shutoff.

MOP STD

This function code allows the standard MOP equations to be offset by a fixed pressure amount. The descriptions are MOP STD, MOP– AND MOP+. The display is FN7 and the selections are 0, +4 and –5. The MOP+ is equal to +4 psig (0.3 Bar). The MOP– is equal to –5 psig (0.3 Bar).

Start Mode Selection

The selection for starting the unit are displayed AUTO OP (code FN10 ON) for auto start operation or MAN OP (code FN10 OFF) for manual start operation.

To start the unit in manual start mode, the START/STOP CONTINUOUS selection must be in “continuous run” mode.

Out-of-Range Selection

The out-of-range temperature tolerance selection is displayed with the description T RANGE or code FN11. The selection are 2, 3, or 4. These selections are the temperature values in degrees C.

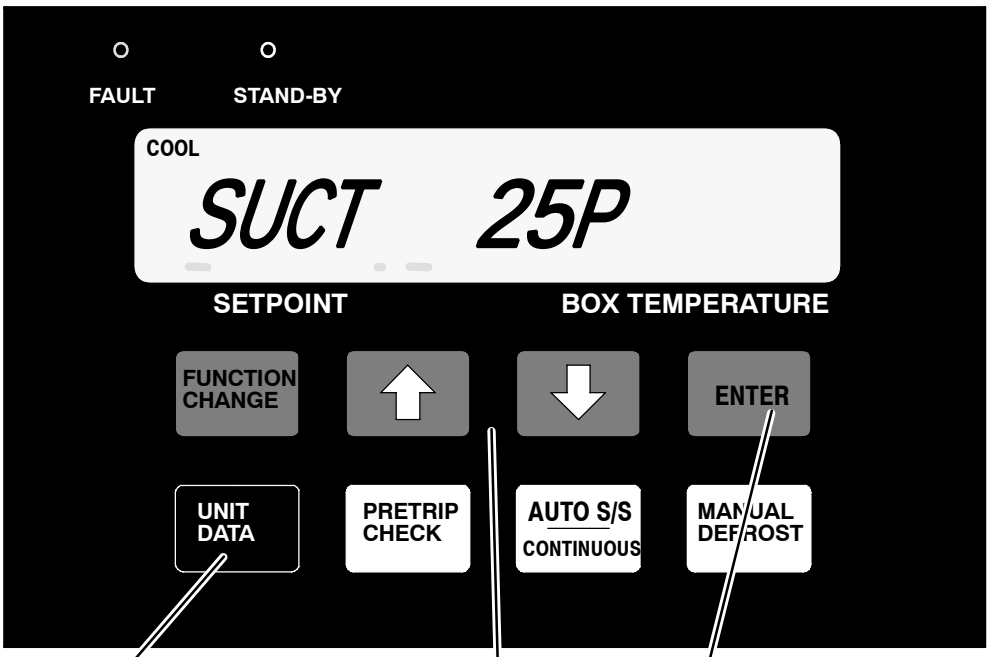
Manual Glow Override Selection

The auto start glow time can be manually overridden through this function. The messages are displayed as NORM GLOW or ADD GLOW. If the ADD GLOW selection is entered, 30 seconds of glow time will be added to the standard glow times. (Refer to Section 4.1.5.) This feature must be selected before the three start attempts have been completed. At higher ambient, this override can only affect the second or third start attempt. The add glow time is de-selected when the engine starts or fails to start. This parameter will not change due to the code vs. English selection.

Alarm Reset

Alarms can be reset through this function. The messages are displayed as ALARM RST or ALARM CLR. If ALARM RST is displayed there is at least one alarm present. Pressing the enter key will clear all alarms. There are no alarms present if ALARM CLR is displayed. This parameter will not change due to the code vs. English selection.

3.9 UNIT DATA



1. Press UNIT DATA key to scroll thru data list one item at a time.

2. To scroll through the list faster, use the UP or DOWN ARROW keys.

3. Data will display for 5 seconds

4. Press the ENTER key to display data for 30 seconds.

The UNIT DATA key can be used to display the unit operating data values. The data values will be displayed for 5 seconds and then the display will revert back to the normal display if no further action is taken. The following sections describe the list of data which can be displayed via the keypad. The description of the data will be displayed on the left side with the actual data on the right side. The unit data list can be scrolled through by pressing the UNIT DATA key. With each successive key push, the list will be advanced one. If the UNIT DATA, UP or DOWN Arrow key is held for one second, the list will change at a rate of one item every 0.5 seconds. This list will be circular, meaning once the end of the list is reached the list will go to the first entry. Each time the UNIT DATA key or the UP/DOWN Arrow key is pressed, the display time will be reset to 5 seconds. If the ENTER key is pressed, the display time will be set to 30 seconds. The position in the unit data list will remain at the last selected value except if power is removed. If the display were to time out and revert to the default display, the operator would only have to press the UNIT DATA key to display the same data again.

3.9.1 UNIT DATA

The following table has columns for Code and English displays. English is the default setting. Change Functional Parameter to Code to see Code display format.

Table 3-2. Unit Data Codes

CODE	ENGLISH	DATA
CD1	SUCT	Suction Pressure
CD2	ENG	Engine Hours
CD3	WT	Coolant Temperature
CD4	RAS	Return Air Temperature
*CD5	SAS	Supply Air Temperature
*CD6	REM	Remote Air Temperature
CD7	ATS	Ambient Air Temperature
CD8	---	Door Open / Closed
CD9	CDT	Discharge Temperature
CD10	BATT	Battery Voltage
CD11	SBY	Standby Hours
CD12	MOD V	Future Expansion
CD13	REV	Software Revision
CD14	SERL	Serial Number Lower
CD15	SERU	Serial Number Upper
CD18	MHR1	Maintenance Hour Meter 1
CD19	MHR2	Maintenance Hour Meter 2
CD20	SON	Switch On Hour Meter

* Codes 5 & 6 are variable. SAS is displayed when the SUP Probe Function is selected. REM is displayed when the REM Probe Function is selected. (See Functional Parameter List in Section 3.8.1.)

Suction Pressure

The suction pressure is displayed with the description SUCT or CD1. The data is displayed with the proper unit designator P (psig) or B (Bars) (i.e. SUCT 25P). The display is in inches of mercury for readings below 0 psig. The display range is -20 HG to 420 psig (-0.7 Bars to 29.4 Bars).

Engine Hours

The number of diesel engine hours is displayed with the description ENG or CD2. The data is displayed with units designator H (i.e. ENG 5040H OR CD2 5040H). The display range is 0 to 99999.

Engine Temperature

The coolant temperature is displayed with the description WT or CD3. The data is displayed with the proper unit designator (Degree C or Degree F (i.e. WT 185F or CD3 185F). The display range is -58°F to 266°F (-50°C to 130°C).

Return Air Temperature

The return air temperature is displayed with the description RAS or CD4. The data is displayed with one decimal place and the proper unit designator, Degree C or Degree F (i.e. RAS 85.0F). The display range is -36°F to 158°F (-38°C to 70°C) in 0.5° increments.

Supply Air Temperature

The supply air temperature is displayed with the description SAS or CD5. The data is displayed with one decimal place and the proper unit designator, Degree C or Degree F (i.e. SAS 85.0F). The display range is -36°F to 158°F (-38°C to 70°C) in 0.5° increments. This unit data will be displayed only if the SUP PROBE is selected in the controlling probe functional parameter. If the probe is bad the display will read --- for the data.

Remote Air Temperature

The remote air temperature is displayed with the description REM or CD6. The data is displayed with one decimal place and the proper unit designator, Degree C or Degree F (i.e. REM 85.0F). The display range is -36°F to 158°F (-38°C to 70°C) IN 0.5° increments. This unit data will be displayed only if the REM PROBE is selected in the controlling probe functional parameter. If the probe is bad the display will read --- for the data.

Ambient Temperature

The ambient temperature is displayed with the description ATS or CD7. The data is displayed with one decimal place and the proper unit designator, Degree C or Degree F, (i.e. ATS 85.0F) . The display range is -36°F to 158°F (-38°C to 70°C) in 0.5° increments. If there is no sensor, then the display will read --- for the data.

Evaporator Temperature Display

The Code display is CD8. The evaporator temperature sensor input will be used as a discrete input to indicate the door open/closed condition. The display will always show dashes, (---).

Discharge Temperature

The discharge temperature is displayed with the description CDT or CD9. The data is displayed with the proper unit designator, Degree C or Degree F, (i.e. CDT 85F) . The display range is -40°F to 392°F (-40°C to 200°C). If there is no sensor, then the display will read --- for the data.

Battery Voltage

The battery voltage is displayed with the description BATT or CD10. The data is displayed with one decimal place and then the capital letter V for volts (i.e. BATT 12.2V or CD10 12.2V). The voltage reading is displayed with a "+" plus sign if the battery status is high enough to allow unit shut down in "Auto Start/Stop".

Standby Hours - Not Applicable

This data is not applicable for this unit. The display is SBY or CD11.

Mod V - Future Expansion

This unit data is not used at this time. The Code display is CD12.

Software Revision

The Eeprom software revision number is displayed with the description REV or CD13 on the left and Eeprom software revision number on the right side. Pressing the ENTER key for 3 seconds will display REV U2 or CD13A on the left and the board mounted software revision number on the right side.

Serial Number Low

The low serial number of the unit is displayed with the description SERL or CD14. The data is the lower 3 digits of the serial number burned into the Eeprom. (i.e. SERL 504 or CD14 504).

Serial Number High

The high serial number of the unit is displayed with the description SERU or CD15. The data is the higher 3 digits of the serial number burned in to the Eeprom. (i.e. SERU 001 or CD15 001).

2 RA - Not Applicable

This data is not applicable for this unit. The display is 2RA or CD16.

3 RA - Not Applicable

This data is not applicable for this unit. The display is 3RA or CD17.

Maintenance Hour Meter 1

The maintenance hour meter 1 setting is displayed with the description MHR1 or CD18. The maintenance hour meter is compared to one of the hour meters (diesel, standby, or switch on) determined by its mode. If the hour meter is greater than the maintenance hour meter an alarm will be generated. The display is MHR1.

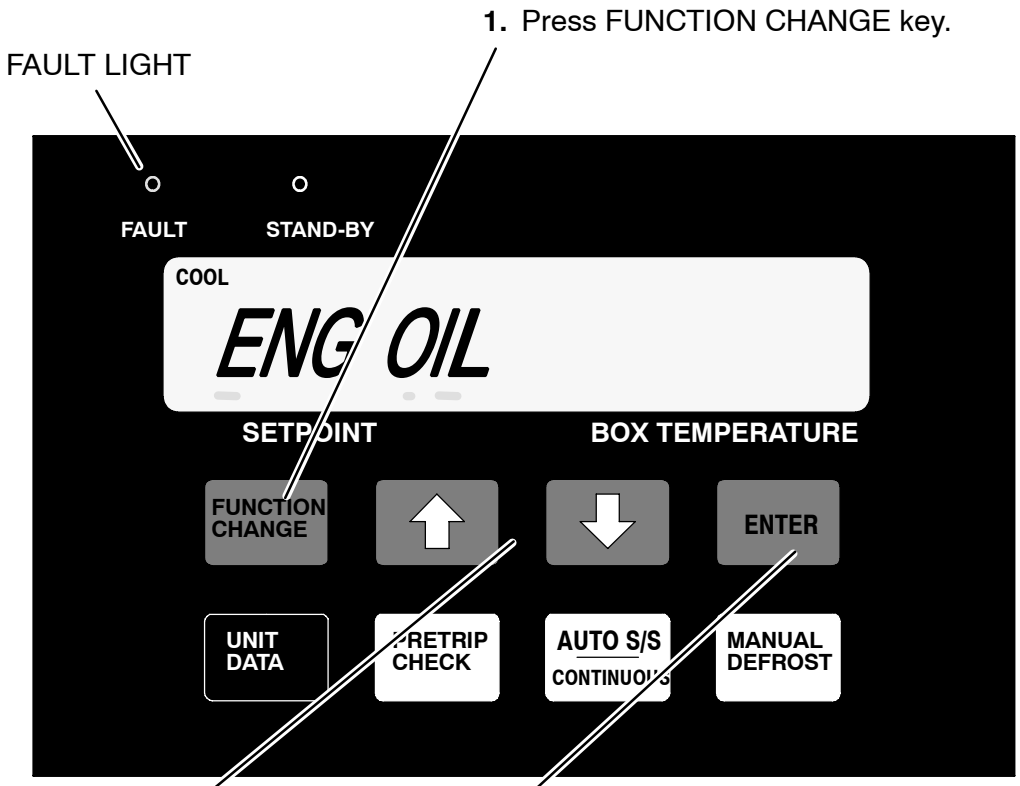
Maintenance Hour Meter 2

The maintenance hour meter 2 setting is displayed with the description MHR2 or CD19. The maintenance hour meter is compared to one of the hour meters (diesel, standby, or switch on) determined by its mode. If the hour meter is greater than the maintenance hour meter an alarm will be generated. The display is MHR2.

Switch On Hour Meter

The number of switch on hours is displayed with the description SON or CD20. The data will be displayed with integer resolution and units designator H (i.e., SON 2347H OR CD20 2347H). The available display range will be 0 to 99999. There will be no space between the designator and the number of hours once the hours are greater than 9999.

3.10 ALARM DISPLAY AND RESET


1. Press FUNCTION CHANGE key.
FAULT LIGHT
FAULT
STAND-BY
COOL
ENG OIL
SETPOINT
BOX TEMPERATURE
FUNCTION CHANGE
ENTER
UNIT DATA
AUTO S/S
MANUAL DEFROST
2. Press UP/DOWN arrow key until ALARM RST is displayed.
3. Press ENTER to clear alarm. ALARM CLR will be displayed. (Unit will restart if alarm condition has been corrected and unit is in Start/Stop or Auto OP.)

The fault light (FL) is turned on only for alarms that specify it. The default display will be overridden if a alarm is generated. When an alarm is generated, the display will alternate the default display (setpoint/air temperature) and the active alarm(s). Each item will be displayed for 3 to 10 seconds, and will continue to scroll through the list. For 5 seconds or the low temperature alternating interval for ambient temperatures at or above 0° F. For temperatures below 0° F, each item will be displayed for 10 seconds.

ALTERNATE ALARM RESET

Place START/RUN-OFF switch to OFF position. (Unit can now be restarted after alarm condition has been corrected.)

The following table has columns for Code and English displays. English is the default setting. Change Functional Parameter to Code to see Code display format.

Table 3-3. Alarm Display

CODE	ENGLISH	ALARM DESCRIPTION
AL0	ENG OIL	✓Low Oil Pressure
AL1	ENG HOT	✓High Coolant Temperature
AL2	HI PRESS	✓High Pressure
AL3	STARTFAIL	✓Auto Start Failure
AL4	LOW BATT	✓Low Battery Voltage
AL5	HI BATT	✓High Battery Voltage
AL6	DEFR FAIL	Defrost Override
AL7	ALT AUX	✓Alternator Not Charging
AL8	STARTER	✓Starter Motor
AL9	RA SENSOR	✓Return Air Sensor
AL10	SA SENSOR	Supply Air Sensor
AL11	WT SENSOR	Coolant Temperature Sensor
AL12	HIGH CDT	✓High Discharge Temperature
AL13	CD SENSOR	Compressor Discharge Temperature Sensor
AL15	FUSE BAD	✓Fuse Blown Or Dirty Battery Cables
AL16	SYSTEM CK	✓Check Refrigeration System
AL17	DISPLAY	Display
AL18	SERVICE 1	Maintenance Hour Meter 1
AL19	SERVICE 2	Maintenance Hour Meter 2
AL20	OUT RANGE	✓ Out-of-range
✓ = FAULT LIGHT ON+		

Low Oil Pressure Alarm

The low oil pressure alarm is displayed with the description ENG OIL or AL0. This alarm is generated if the control senses low oil pressure under the proper conditions. The fault light (FL) is turned on. Engine will shut down. Oil pressure switch must be open for 15 seconds to generate alarm.

High Coolant Temperature Alarm

The high coolant temperature alarm is displayed with the description ENG HOT or AL1. This alarm is generated if the control senses a high coolant temperature 230 to 240°F (110 to 116°C) for 5 minutes or immediately if over 240°F (116°C). The fault light (FL) is turned on and engine will shut down. Prior to S/N S/N KAK90661828 the engine coolant temperature sensor (WTS) was located on the rear of the thermostat housing on the engine cylinder head. Beginning with S/N KAK90661828 the sensor is located on the front of the engine near #4 injector.

High Pressure Alarm

The high pressure alarm is displayed with the description HI PRESS or AL2. This alarm is generated if the high pressure switch opens. The fault light (FL) is turned on and engine will shut down for a minimum of 2 minutes. This 2–minute timer can be overridden by turning power off and back on. The alarm will reset when the control power is cycled as long as the high pressure switch has reset, or high pressure has fallen below 350 ± 10 psig (23.8 Bar).

Auto Start Failure Alarm

The auto start failure alarm is displayed with the description STARTFAIL or AL3. This alarm is generated if the engine fails to start. The fault light (FL) is turned on.

The alarm STARTFAIL is also generated if the system fails to heat three consecutive times. Once activated for this condition, the engine will be prevented from starting until the alarm is cleared or power is cycled on the controller.

Alarm will not be generated when the unit is defrosting, executing pretrip, or when run relay is open, or the engine not running. If any of these conditions occur while any of the three (3) error timers are running the timers will be cleared.

If function MAN OP (manual start mode) is selected the start failure alarm will be generated if the engine is not started in 5 minutes.

Low Battery Voltage Alarm

The low battery voltage alarm is displayed with the description LOW BATT or AL4. This alarm is generated if the battery voltage falls below 10 VDC. The fault light (FL) is turned on and engine will shut down when:

- The engine is off and Software Version is greater than or equal to 3.27 and Auto Start has not started cranking the engine (Initial Startup or Start/Stop restart) – The fault light is turned on immediately.
- The engine is off and Software Version is greater than or equal to 3.27 and Auto Start has started cranking the engine (Initial Startup or Start/Stop restart) – The fault light is prevented from turning on for 15 seconds. If the engine fails to start after 15 Seconds, the fault light will turn on immediately if the voltage is still lower than 10 VDC.
- Engine Running – Fault light will turn on if the battery voltage is less than 10 VDC for 5 continuous seconds. If the battery voltage goes to a value greater than or equal to 10 VDC the 5 second timer is reset.

High Battery Voltage Alarm

The high battery voltage alarm is displayed with the description HI BATT or AL5. This alarm is generated if the battery voltage is above 17 VDC. The fault light (FL) is turned on and engine will shut down.

Defrost Override Alarm

The defrost override alarm is displayed with the description DEFR FAIL or AL6. This alarm is generated if the unit is in a defrost override mode (See Section 4.2.2).

Alternator Auxiliary Alarm

The alternator auxiliary alarm is displayed with the description ALT AUX or AL7. This alarm is generated if the alternator auxiliary signal is not present with the engine running and the ALT AUX signal is not present for any 5 consecutive second period. The fault light (FL) is turned on.

Starter Motor Alarm

The starter motor alarm is displayed with the description STARTER or AL8. This alarm is generated if the starter motor input signal is not present with starter solenoid energized. The fault light (FL) is turned on.

Return Air Sensor Alarm

The return air sensor alarm is displayed with the description RA SENSOR or AL9. This alarm is generated if the return air sensor is open or shorted. The fault light (FL) is turned on if the unit shuts down because there is no controlling probe.

Supply Air Sensor Alarm

The supply air sensor alarm is displayed with the description SA SENSOR or AL10. This alarm is generated if the supply air sensor is open or shorted. This alarm will be disabled if the REM PROBE is selected in the controlling probe functional parameter. The exception to the SA SENSOR alarm being disabled is if the REM PROBE is selected and configuration bit 15, UltraFresh 2, is active.

Coolant Temperature Sensor Alarm

The coolant temperature sensor alarm is displayed with the description WT SENSOR or AL11. This alarm is generated if the coolant temperature sensor circuit is open or shorted.

Discharge Temperature Alarm

The compressor discharge temperature alarm is displayed with the description HIGH CDT or AL12. This alarm is generated and unit shuts down if the temperature is sensed above 310° F (154.4°C) for 3 minutes. If the discharge temperature exceeds 350° F (176.7°C), the 3 minute timer will be overridden and the unit will shut down immediately. If ambient temperature sensor (ATS) is greater than 120°F (49°C) the CDT limits are increased to 340°F (171°C) for 3 minutes. The fault light (FL) is turned on. The compressor discharge temperature sensor is located in the center head of the compressor.

Discharge Temperature Sensor Alarm

The compressor discharge temperature sensor alarm is displayed with the description CD SENSOR or AL13. This alarm is generated if the sensor is open or shorted. If the CNF2 is setup for no discharge sensor, then the high discharge temperature alarm will be disabled since the discharge temperature determines this alarm.

SBY Motor – Not Applicable

This alarm is not applicable for this unit. The display is SBY MOTOR or AL14.

Fuse Alarm

The fuse alarm is displayed with the description FUSE BAD or AL15. This alarm is generated when the FUSE input is sensed low. The fault light (FL) is turned on. The engine will shut down.

Display Alarm

When no communications exist between the main board and the display board for 8 seconds, the display alarm is generated and the display is DISPLAY or AL17.

Maintenance Hour Meter 1 Alarm

The maintenance hour meter alarm 1 is displayed with the description SERVICE 1 or AL18. This alarm is generated when the designated hour meter is greater than maintenance hour meter 1.

Maintenance Hour Meter 2 Alarm

The maintenance hour meter alarm 2 is displayed with the description SERVICE 2 or AL19. This alarm is generated when the designated hour meter is greater than maintenance hour meter 2.

Out-of-Range Alarm

The out-of-range alarm is displayed with the description RAS OUT or AL20. This alarm is generated when the refrigerated compartment is out-of-range Refer to Section 3.8.1. The fault light (FL) is turned on.

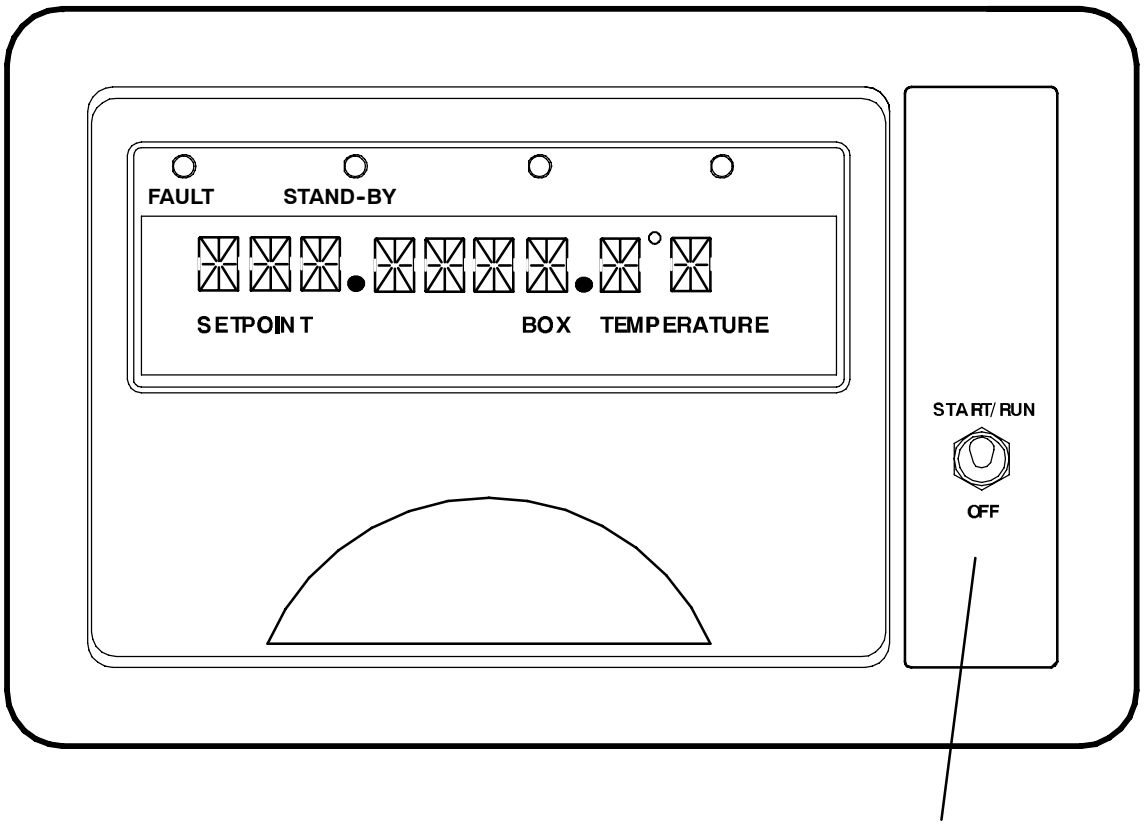
System Check Alarm (CNF18 must be On)

The system check alarm is displayed with the description SYSTEM CK or AL23 if CNF 18 is On.

The SYSTEM CK alarm is generated when any of the following conditions occur:

- If the unit is in cool mode (and not in the UltraFresh 2 or UltraFreeze null or heat bands), and the supply air temperature becomes 5°F (2.8°C) higher than the return air temperature for five continuous minutes.
- If the suction pressure becomes greater than 100 psig (6.8 Bar) in heat mode for 60 continuous seconds for both perishable and frozen setpoints. If the suction pressure becomes less than –10.2 inHg (–0.34 Bar) for 120 continuous seconds while the refrigerated compartment is in cool mode and while the return air temperature for the compartment is greater than 0°F (–17.8°C) and the ambient temperature is greater than or equal to 40°F (4.4°C) the alarm will be activated.
- If either the return or supply probe fails only the suction pressure logic will be used to test for the alarm conditions. In case of either probe failing, the 5 minute supply temperature greater than return by 5°F (2.8°C) is not done. With a single probe, the heat and cool 60 or 120 second suction pressure tests will be run. If both probes are defective none of this logic is executed.
- If the system transitions to heating mode (not null, not defrost), a check that the system is heating properly will be performed. This check will start five minutes after the unit transitions to Heat. The system will be determined to be heating if SAS is greater than (RAS–1.5°C). The check will be performed as long as the system continues to operate in Heat. If heating is not detected for one minute the system will shut down for 15 minutes and the SYSTEM CK alarm will be activated. The engine will be allowed to restart after the 15 minutes expires unless the system has failed to heat three times in which case the STARTFAIL alarm will also be activated. Once three successive failures are detected the engine will not be restarted unless alarms are cleared or power is cycled on the control.
- The SYSTEM CK alarm logic will not be active while the unit is in defrost, pretrip, or anytime the run relay is de-energized.

3.11 STOPPING UNIT



1. To stop the unit, place the START/RUN - OFF switch tin the OFF position.

The diesel engine will stop and the microprocessor controller will turn off. The Microprocessor Main Display and all indicator LEDs will also turn off.

SECTION 4 - ENGINE AND TEMPERATURE CONTROL

4.1 AUTO START/STOP OPERATION

Automatic start/stop is provided to permit starting/restarting of the diesel-driven compressor as required. This feature fully enables automatic control of the diesel engine starting and stopping. The main function of automatic engine cycling is to turn off the refrigeration system near setpoint to provide a fuel efficient temperature control system and to initiate a restart sequence after conditions are met. System shut-off is allowed only if the battery condition signal is good (+sign in front of voltage reading in Unit Data List). The engine coolant temperature shall override the minimum off time and out-of--range condition to force engine restarting when the engine coolant temperature drops below 34° F (1°C). A restart will also be initiated if the battery voltage falls below 12.2 VDC. (11.0 VDC for units with EEPROM Rev 3.24 and lower – Refer to Section 3.9.1 for unit data.) A restart will also be initiated if box temperature is more than 11°F (6°C) from set point.

NOTE

The unit will remain in low speed for 5 minutes after engine start-up when: Auto Start/Stop is at any setpoint or Continuous Run setpoint is below 10°F (–12°C).

4.1.1 Start/Stop – Continuous

A key is provided to select between continuous run and auto start/stop operating mode. In the continuous run mode, the diesel engine will not shut down except for safeties or if the engine stalls. This function also apply to the operation of the electric motor.

4.1.2 Auto Mode Indicator

The “Auto Start/Stop” indicator is lit and ARL light (8–light bar only) will be on to indicate the start/stop mode has been selected.

4.1.3 Auto Start Failure

If the unit fails to start, shuts down on a safety, or fails to run for the minimum run time, three consecutive times, the “Auto Start/Failure” is activated.

4.1.4 Auto Start Sequence

When the starting conditions are met, the start sequence will begin by energizing the run relay, and after 5 seconds energize the glow plug relay (GPR) to supply power to the glow plugs, units with buzzer will sound for 5 seconds then the starter is energized. On initial power-up, the control will delay 5 seconds before the starting sequence begins. If the required glow time is zero, the control will energize the starter after a 5 second delay. After a period of time , the starter solenoid (SS) is energized to crank the engine. The engine will crank for 10 seconds or until engine operation is sensed by the alternator signal. The glow relay will be de-energized after the auxiliary input is sensed on. A 15 second null cycle will elapse before subsequent start attempts. The run relay will remain energized until the next starting sequence.

Before the next starting sequence, the oil pressure is checked to determine if the engine is running and the alternator auxiliary has failed. For the second and third start attempts the glow time is increased by 5 seconds over the glow time of the first attempt listed below. The control allows three consecutive start attempts before the starting is locked out and the start failure alarm is activated.

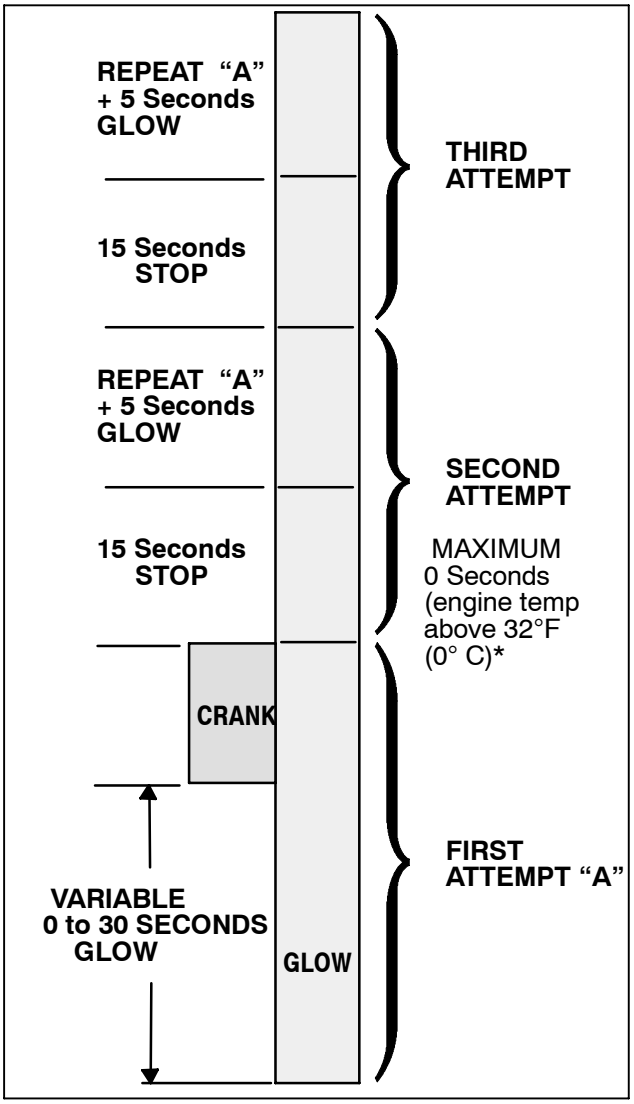


Figure 4-1. Auto Start Sequence

***NOTE**

When engine coolant temperature is below 32°F (0°C).

4.1.5 Variable Glow Time

The glow time for the first start attempt will vary in duration based on engine coolant temperature and the engine as follows:

Table 4-1. Auto Start Glow Time		
Engine Coolant Temperature	Glow Time in Seconds	
	TV	DI
Less than 32°F (0°C)	15	55
33°F to 50°F (1°C to 10°C)	10	40
51°F to 77°F (11°C to 25°C)	5	25
Greater than 78°F (26°C)	0	10

The second and third start attempts have a glow time that is 5 seconds greater than the table amount. The glow time can be manually overridden through the function parameters. If the coolant temperature sensor is defective the control assume a temperature of less than 32°F (0°C) for the glow timing.

4.1.6 Minimum On Time

The on-time is 4 or 7 minutes. Refer to Section 3.8.1

After the minimum on-time, the unit will go to fully loaded for setpoints greater than 10°F (–12°C) and high speed loaded for setpoints of 10°F (–12°C) or less.

The unit will not cycle off if the engine coolant temperature is less than 122°F (50°C) or the battery is not good. If the unit can not cycle off, it will operate normally in continuous mode. If all temperature probes fail and the setpoint is 10°F (–12°C) or less, the unit will not shut down.

The unit will shut down when the box temperature is within ±0.5°F (±0.3°C) of setpoint for setpoints in the Perishable range or +0.5°F (+0.3°C) above setpoint for setpoints in the Frozen range.

4.1.7 Minimum Off-Time

Keypad provision is provided to select the minimum off--time of 10, 20, 30, 45 or 90 minutes. Refer to Section 3.8.1

After the minimum off-time, the unit will restart for temperatures beyond ±3.6°F (±2.0°C) of setpoint for the Perishable range or above +3.6°F (+2.0°C) of setpoint for the Frozen range.

The minimum off-time is overridden if the temperature is more than ±11°F (±6°C) from setpoint.

NOTE for X2 units only:

When the unit has cycled OFF in Start/Stop, and the ambient air temperature is at, or rises to +115°F (46°C) HR2 will energize and open the SV4 valve for 45 seconds to equalize the refrigerant system pressures across the high and low pressure sides of the system. While the SV4 valve is energized, the Heat Light will also be on (8–Light Bar only) even though the engine is not running.

4.1.8 Battery Voltage

Provisions are made to sense when the battery is good. A good battery is defined as having 13.4v at 75°F (23.9°C). This condition is used to allow shut- off of the diesel engine.

If the battery voltage falls below 10v during glow cycle, the starter will not engage and the start sequence will continue, this is considered a failed start. The start sequence will be repeated until the unit starts or three consecutive start attempts have failed.

Table 4-2. Battery Voltages		
Message Display	Voltage Level	Description
LOW BATT AL4	10 or Less	Unit will shut down except during cranking.
	11 to 13.4	If the unit has cycled off in auto start/-stop mode and battery voltage drops below 11.0 volts (12.2 volts for Rev. 3.25 and higher), the unit is automatically started to charge battery. Unit will operate until a battery voltage of 13.4 volts is obtained at which level unit will stop if temperatures are satisfied.
HI BATT AL5	17 or more	Unit will shut down.

4.1.9 Oil Pressure Signal

When the oil pressure switch is closed it shows that the engine is running and prevents engagement of the starter motor when operating in the auto mode. (Refer to Section 2.3 for oil pressure switch settings.)

4.1.10 Maximum Off-Time

Provision for a keypad selectable feature is provided which will cause the engine to be started 30 minutes after the engine has stopped regardless of the box temperature. Refer to Section 3.8.1

4.2 TEMPERATURE CONTROL

4.2.1 Heat/Cool Mode

The system is configured for cooling mode for engine start and during the oil pressure delay.

Hot gas heating is applied by energizing the HR1 and HR2 relays which will energize the hot gas solenoids. These relays will also control the remote heat and cool lights (8–Light Bar only).

For UltraFreeze Refer to Section 4.4.

a. Cooling

There are two control ranges, Frozen and Perishable. The Frozen range is active with set points at or *below* +*10*°F *(–12°C*) and the Perishable range is active at set points *above* +*10*°F *(–12°C*).

The controller automatically selects the mode(s) necessary to maintain box temperature at set point.

Refer to Section 4.3 for description of UltraFresh 2.

If the unit is in high speed loaded cool, the microprocessor will pull terminal 38 low to energize the speed relay. A set of normally open contacts (SR) close to energize the speed control solenoid (SCS). The engine will be in high speed.

When the unit is running in high speed loaded cool and with the evaporator coil temperature below 40°F (4.4°C) to close at least one defrost termination thermostat, a pre-trip may be initiated by depressing the PRE-TRIP key. The operator now may verify the pre-trip sequence. (Refer to Section 3.3)

As the trailer temperature falls toward set point, the microprocessor will place the unit in low speed loaded cool. The temperature at which this occurs is not fixed but depends upon the rate at which the trailer temperature is approaching set point.

The speed relay (SR) de-energizes to open the circuit to the speed control solenoid (SCS). Engine speed decreases from high speed to low speed.

As the trailer temperature falls closer to set point, the controller will shift the operation from low speed loaded cool to low speed unloaded cool to further reduce cooling capacity. To do this, the microprocessor will pull terminals 57 or 57 & 56 low, completing the ground path for the unloader relays (UFR & URR). The coils energize to close the UFR & URR contacts. One or both unloaders (UF and UR) may energize to unload the compressor (Refer to Section 4.5.1).

With decreasing temperature, the unit will shift to low speed unloaded heat Refer to Section 4.4.

Unit will remain in various stages of heating until the box temperature increases enough to place the unit in the low speed unloaded cool mode. As the box temperature increases, the unit will shift to low speed loaded cool , and then to high speed cool mode (speed relay energizes).

NOTE

High Speed Cool is locked out for 10 minutes after switching from Null to Cool, or from High Speed Cool to Low Speed Cool, when CNF15 is ON (UltraFresh II enabled). There is no delay when CNF15 is OFF.

b. Heating

NOTE

Whenever the unit shifts to heat or defrost, HR1 and HR2 energize simultaneously. When switching from heat (or defrost) to cool, HR1 de-energizes 2 seconds before HR2. This allows time for SV-1 to open and clear the condenser of liquid before SV4 closes. This will eliminate any high pressure buildup which could occur. During this time, only on a remote 8–light bar, the heat and cool lights will be on together. The heat and cool display on the control panel change immediately.

NOTE for X2 units only:

When the unit has cycled Off in Start/Stop, and the ambient air temperature is at, or rises to +115°F (46°C) HR2 will energize and open the SV4 valve for 45 seconds to equalize the refrigerant system pressures across the high and low pressure sides of the system. While the SV4 valve is energized, the Heat Light will also be on (8–Light Bar only) even though the engine is not running.

Refer to Section 2.16 for description on heating cycle.

Refer to Section 4.4 for description of UltraFreeze.

The controller automatically selects the mode(s) necessary to maintain box temperature at set point. The heating modes are as follows with descending temperatures:

(a) Low Speed Unloaded Heating, (b) Low Speed Loaded Heating, (c) High Speed Loaded Heating

The controller will shift the unit into low speed unloaded heat when the trailer temperature falls below set point (compressor in four cylinder heating). The microprocessor pulls terminals 37, 55 and 57 low to complete the ground paths for the heat relays (HR1 and HR2) and unloader front relay (UFR). When these relays energize, several things happen. This opens the (N.C.) contacts to the cool light on an 8–light bar and solenoid valve (SV2). SV2 now operates in conjunction with the head pressure control switch (HP2). (Refer to section 2.16)

Also, HR1 closes a set of normally open contacts to energize solenoid valve SV1 to close the condenser outlet line.

When the unloader front relay (UFR) energizes, a set of N.O. contacts (UFR) close to energize the compressor front unloader (UF). Compressor will be in four cylinder heating.

Energizing HR2 closes two sets of N.O. contacts. Solenoid SV4 energizes and opens to allow hot refrigerant vapor to enter the evaporator (section 2.16). The other set of HR2 contacts supply power to the heat light on an 8–light bar.

If more heating capacity is required, the unit will shift to low speed loaded heating. The microprocessor will break the ground path to de-energize the front unloader relay, which in turn, de-energizes the compressor unloaders (compressor shifts from four cylinder to six cylinder operation).

NOTE

High speed heat is locked out for 1 minute after switching from cool to heat, when CNF15 is ON (UltraFresh II enabled). High speed heat is locked out for 5 minutes after switching from cool to heat, when CNF15 is OFF.

When maximum heating capacity is required, the unit will shift to high speed loaded heat. The microprocessor energizes the HR1, HR2, and speed relay (SR) coils. Terminals 37, 55 and 38 will be pulled low. The only change from the low speed loaded heat mode is that the speed relay is now energized. SR contacts close to energize the speed control solenoid (SCS). The engine will be in high speed.

4.2.2 Defrost Cycle

NOTE

The unit will be in high speed in defrost mode.

If both defrost thermostats (klixons) are open (no voltage at 31), defrost cannot be initiated by any means. (A few models may have only one DTT).

Defrost is an independent cycle overriding cooling and heating functions to de-ice the evaporator as required. The controller displays "DF" during defrost mode on the right hand temperature display. The left hand display will continue to display the setpoint.

In defrost the microprocessor pulls terminals 37, 55, and 38 low to shift the unit into high speed heat. The processor also pulls terminal 53 low to energize the defrost relay coil. This closes the N.O. defrost relay contacts to energize the defrost light on the remote 8–light bar. The defrost and heat display will also be illuminated.

Also N.C. defrost relay contacts open to de-energize the clutch (CLH) to stop the evaporator fan.

Defrost will continue and does not terminate until the microprocessor senses both defrost termination thermostats [DTT(s)] reach termination temperature and open, or the compressor discharge temperature (CDT) reaches 310° F (154.4°C) for 1 continuous minute. If the unit should remain in Defrost for 45 minutes, the Fail Safe Defrost Termination logic will stop the Defrost Cycle, and put the unit into temperature control mode (see section 4.2.2.e.).

If the problem corrects itself, (thermostats opens for example), the unit will automatically resume its normal functions).

The defrost mode may be initiated by three different ways if the evaporator coil is cold enough for one of the defrost klixons (DTT) to be closed (box temperature below approx. 40°F (4.4°C). (Refer to Section 2.12). These methods are:

a. Defrost Timer Initiation

A defrost timer initiation is a keyboard selection (Refer to Section 3.8.1). The Defrost Timer runs and accumulates time when the unit is operating, and at least one of the DTTs is closed. The timer does not accumulate time during defrost mode, during auto-start off cycles The defrost timer is reset to zero whenever a defrost cycle is initiated, or the unit is turned off. .

b. Defrost Air Switch Initiation

An external defrost signal (DA) may be supplied as a set of normally open switch contacts closing to initiate the defrost cycle.

The switch is an air pressure differential switch which measures air pressure differential across the evaporator coil and initiates the defrost cycle when the air pressure differential increases enough to close the DA contacts, such as would happen when excessive frost builds up on the evaporator coil surface.

When the defrost air switch contacts close, there is a 12 vdc potential to terminal 33 on the microprocessor. The microprocessor looks for voltage at terminal 31. Voltage at 31 indicates that at least one defrost termination thermostat is closed. The unit will shift to the defrost mode if voltage is present at 31.

c. Manual Defrost Initiation

The defrost cycle may be initiated by pushing the MANUAL DEFROST key.

d. Normal Defrost Mode (Ambient temperatures less than 80°F (26.7°C)

The defrost mode may be initiated by either of the three methods just described above. Once a Defrost Cycle has been initiated, Defrost will continue and does not terminate until the microprocessor senses both defrost termination thermostats ([DTT(s)] reach termination temperature and open, removing the 12 VDC signal to terminal 31 of the microprocessor, or the compressor discharge temperature (CDT) reaches 310°F (154.4°C) for 1 continuous minute.

The defrost relay is energized during defrost mode to open the normally open contacts within the Defrost Relay, which will de-energize the clutch and stop the evaporator fan to prevent hot air circulation to the load.

In addition, the speed and heating outputs (SR, HR1 & HR2) are enabled to apply high-speed heat for hot gas heating.

The compressor operates at maximum capacity on diesel and diesel/electric units during defrost. The suction pressure signal can force the unloaders to be unloaded. The compressor will operate on either 4 or 6 cylinders during the Defrost Cycle.

Suction Pressure Control

For all XT and X2 model units, in addition to loading and unloading the front unloader based on the suction pressure (Refer to section 4.2.4), after the unit has been in the Defrost Cycle for more than 90 seconds, the suction pressure will be monitored to help keep it from going too high. If the suction pressure rises to 57 psig (3.9 Bar), HR1 will de−energize to open SV1 for one second, then energize again. The opening of SV1 will decrease the discharge pressure, which will keep the suction pressure lower. This will not occur more than 2 times each minute.

e. Fail Safe Defrost Termination

Should the defrost cycle not complete within 45 minutes or if the defrost air switch contacts do not open at defrost termination, the defrost cycle is terminated. The internal timer is reset for 1.5 hours and the external defrost signal is ignored for defrost initiation. The manual defrost switch will override this mode and start a new 45 minute cycle. When defrost override is active, the Defrost Fail alarm will be indicated. If the run relay is de-energized during defrost (due to a shut down alarm, or the Start/-Run Off Switch being turned off) defrost will be terminated.

f. Defrost Termination at Low Speed

The defrost terminates with HR1 and speed relay de--energizing. This places the engine in low speed, and opens the SV1 solenoid valve. HR2 will turn off 2 seconds later,closing SV4. The defrost relay will de-energize 5 seconds after HR1 to engage the clutch. If the temperature control requires high speed, there will be a 2 second delay after the defrost relay is de-energized.

g. High Ambient Defrost (Ambient air temperature is Greater Than 80°F (26.7°C)

When the ambient is greater than 80°F (26.7°C) the following stages are performed for defrost (Refer to Table 4-3).

- Stage 1 (Pump Down) runs for a minimum of thirty seconds and then checks the suction pressure. When the suction pressure is less than 10 PSIG, it will continue to stage 2. The total time in stage one cannot be greater than 330 seconds. If 330 seconds is reached stage two will automatically be entered regardless of suction pressure.
- Stage 2 is defrost. HR1 will be energized to close the SV1 valve. HR2 will energize to open the SV4 valve, and turn off the Cool Light and turn on the Heat Light (8−light bar). HR4 will energize to allow HP2 to control SV2 valve opening and closing. DR is energized turn on the Defrost Light (8−light bar) to de--energize the clutch to stop the evaporator fan and prevent hot air circulation to the load. SR will be energized to put the engine into high speed.
- Stage 3 (Defrost Termination) is the termination of defrost. Defrost will terminate when the microprocessor senses both defrost termination thermostats [DTT(s)] have reached termination temperature and open, or the compressor discharge temperature (CDT) reaches 310° F (154.4°C) for 1 continuous minute.

High Ambient Defrost terminates with HR1 and HR4 de--energizing, and UFR energizing. This opens the SV1 and SV2 valves turns off the Heat Light and turns on the Cool Light (8−light bar), and unloads the Front Unloader. After the suction pressure has risen by 10 psig, or in a maximum of 15 seconds, the SR and HR2 will de−energize and the engine will go to low speed, and SV4 will close. URR will energize and unload the Rear Unloader. After 5 seconds the DR will de-energize to engage the clutch and turn off the Defrost Light (8−light bar). After another 5 seconds the unit will return to normal temperature control.

If the unit should remain in High Ambient Defrost for 45 minutes, the Fail Safe Defrost Termination logic will stop the Defrost Cycle, and put the unit into temperature control mode (see section NO TAG).

Table 4-3. Stages for High Ambient Defrost (Ambient temperature Greater Than 80 °F (26.7°C)						
STAGE	**SV1 (HR1)**	**SV2 (HR4)**	**SV4 (HR2)**	**UR**	**UF**	**SPEED**
1	OPEN (De-energ)	CLOSED (Energ)	CLOSED (De-energ)	Energ	Energ	Low De-energ
2	CLOSED (Energ)	HP2 Control	OPEN (Energ)	De-energ	Energ	High Energ
3	OPEN (De-energ)	OPEN (De-energ)	OPEN (Energ)	De-energ	Energ	Low De-energ
De-energ = De-energized Energ = Energized						

4.2.3 Unloader Operation

a. Unloading in Temperature Mode

The compressor is equipped with unloaders (electronically controlled by the microprocessor) for capacity control.

The capacity controlled cylinders are easily identified by the solenoid which extends from the upper side of the cylinder head. When the solenoid coil is energized the cylinders unload. The unloaded cylinders operate with little or no pressure differential, consuming very little power. A de-energized solenoid coil reloads the cylinders.

NOTES

1. The unloader relay is locked in for a minimum of 2 minutes once it is energized due to suction pressure.
2. There is a delay of 30 seconds between de--energizing one unloader to de-energizing the other unloader.

There are two modes of unloader operation, temperature control and suction pressure control.

b. Temperature Control Within 1.4°F (0.8°C) of Set Point

1. Cool LED or Heat LED on the display and for units with an 8–light bar, Cool light (CL) or heat light (HL) illuminated (depending on mode of operation).
2. If in low speed cooling, unloader relays (UFR, or UFR & URR) may energize to unload those compressor cylinders. Refer to Table 4-4
3. The heat mode forces the rear unloader (UR) to a loaded condition (de-energized) for diesel operation. In low speed heating, front unloader relay (UFR) may energize to unload the front compressor cylinders.

Table 4-4. Unloading in Temperature Mode			
SETPOINT AT OR BELOW 10°F (-12°C)	**CYLINDER**	**SETPOINT ABOVE 10°F (-12°C)**	**CYLINDER**
Cool High Speed	6	Cool High Speed	6
		Cool Low Speed	4
		Cool Low Speed	2
		Heat Low Speed	4
Cool Low Speed	6	Heat Low Speed	6
Cool Low Speed	4	Heat High Speed	6

c. Perishable Set Point (+10°F (-12°C) or lower) Cooling Unloader Control (UltraFresh I)

During perishable cooling the unloaders are energized when the temperature approaches setpoint. If a supply air temperature probe is present the unloaders are energized when the supply air temperature decreases 5.4°F (3°C) below setpoint. It will stay unloaded until the supply air temperature rises above setpoint. If a supply probe is not present the unloaders are energized when the return air temperature is less than 9°F (5°C) above setpoint. It will stay unloaded until the return temperature rises to more than 14.4°F (8°C) above setpoint. The return air probe logic is disabled for ambient temperature higher than 90°F (32.2°C).

d. Perishable Set Point [+11°F (-11°C) and higher] Heating Unloader Control

During perishable heating the front unloader is energized when the control temperature increases to 0.9°F (0.5°C) below setpoint. The unloader will stay energized until the control temperature decreases to 1.5°F (0.8°C) below setpoint.

NOTE

These switch points may vary slightly depending on the amount of overshoot around setpoint.

e. Frozen Set Point Unloader Control CNF 17 UltraFreeze On/Off

For units with UltraFreeze Refer to Section 4.4.

For units without UltraFreeze during frozen mode, heating is not allowed. The front unloader is energized when the control temperature decreases to 1.5°F (0.8°C) above setpoint. The unloader will stay energized until the control temperature reaches 2°F (1.1°C) above setpoint.

NOTE

During frozen mode only the front cylinder can be unloaded.

4.2.4 Suction Pressure Operation

The microprocessor will monitor suction pressure of the refrigeration system and control the unloaders to load (de–energize) as the suction pressure drops and unload (energize) as the suction pressure rises.. A suction pressure transducer is used to signal the microprocessor when to load or unload the compressor.

During the diesel heating and defrosting cycles, the rear unloader is always loaded, forcing the compressor to operate with at least four cylinders loaded.

High Ambient Override for XT and X2 Models only (CNF 19 ON)

NOTE

XT and X2 model units (REV 3.25 and higher with CNF 19 ON) use the suction pressure loading & unloading chart (See Figure 4-2, but also use the following overrides during unit operation:

For ambient air temperatures above 125°F (52°C), or if the Ambient Air Sensor is defective, suction pressure will determine when the Front or Rear Unloader will load or unload (See Figure 4-2).

For ambient air temperatures between 125°F and 110°F (52°C to 43°C),the Rear Unloader (UR) will operate per the suction pressure chart (See Figure 4-2) for the first 30 seconds after the engine starts. After that time, the UR will be de–energized and loaded, regardless of suction pressure.

For ambient air temperatures below 110°F (43°C) the Rear Unloader (UR) will be de–energized regardless of suction pressure, while the engine is running.

High Box Temperature Pulldown Logic

NOTE

XT and X2 model units (REV 3.25 and higher with CNF 19 ON) use the suction pressure loading & unloading chart (See Figure 4-2), but also use the following overrides during unit operation:

When the unit is running in High Speed 4–Cylinder Cool operation, and the suction pressure drops to 10 PSIG (0.68 Bar) above the normal cut–in point for UF (See Figure 4-2), the front unloader is loaded for 15 seconds. If the suction pressure drops below the cut–in point, the front unloader will remain loaded. If the suction pressure remains above the cut–in point, the front unloader will unload after the 15 seconds. This cycle will repeat every 2 minutes, until either the suction pressure is low enough to load the front unloader, or the cycle repeats 10 times. Should the front unloader not remain loaded after 10 attempts, the cycle will be extended to 30–minute intervals.

When the unit is running in High Speed 4–Cylinder Cool operation, and the suction pressure drops to 10 PSIG (0.68 Bar) above the normal cut–in point for UF (See Figure 4-2), the front unloader is loaded for 15 seconds. If the suction pressure drops below the cut–in point, the front unloader will remain loaded. If the suction pressure remains above the cut–in point, the front unloader will unload after the 15 seconds. This cycle will repeat every 2 minutes, until either the suction pressure is low enough to load the front unloader, or the cycle repeats 10 times. Should the front unloader not remain loaded after 10 attempts, the cycle will be extended to 30–minute intervals.

a. At ambient temperatures of 90°F (32.2°C) or below

NOTE

The following information applies to all units. However, the UR and UF in XT and X2 model will operate with the overrides described earlier with a higher priority than this logic.

When the system is operating at *high speed* and the suction pressure is greater than 64 PSIG (4.3 Bar), both unloader banks are unloaded. As the suction pressure drops below 64 PSIG (4.3 Bar), rear bank is loaded. If the suction pressure drops below 33 PSIG (2.2 Bar), the front bank is loaded.

When the system is operating at *low speed* and the suction pressure is greater than 65 PSIG (4.4 Bar), both unloader banks are unloaded. As the suction pressure drops below 64 PSIG (4.3 Bar), rear bank is loaded. If the suction pressure drops below 35 PSIG (2.4 Bar), the front bank is loaded.

b. At ambient temperatures of 90°F (32.2°C) or higher

At ambient temperatures of 90°F (32.2°C) or higher the unloading suction pressure settings relative to ambient temperatures are a straight line.(Refer to chart below)

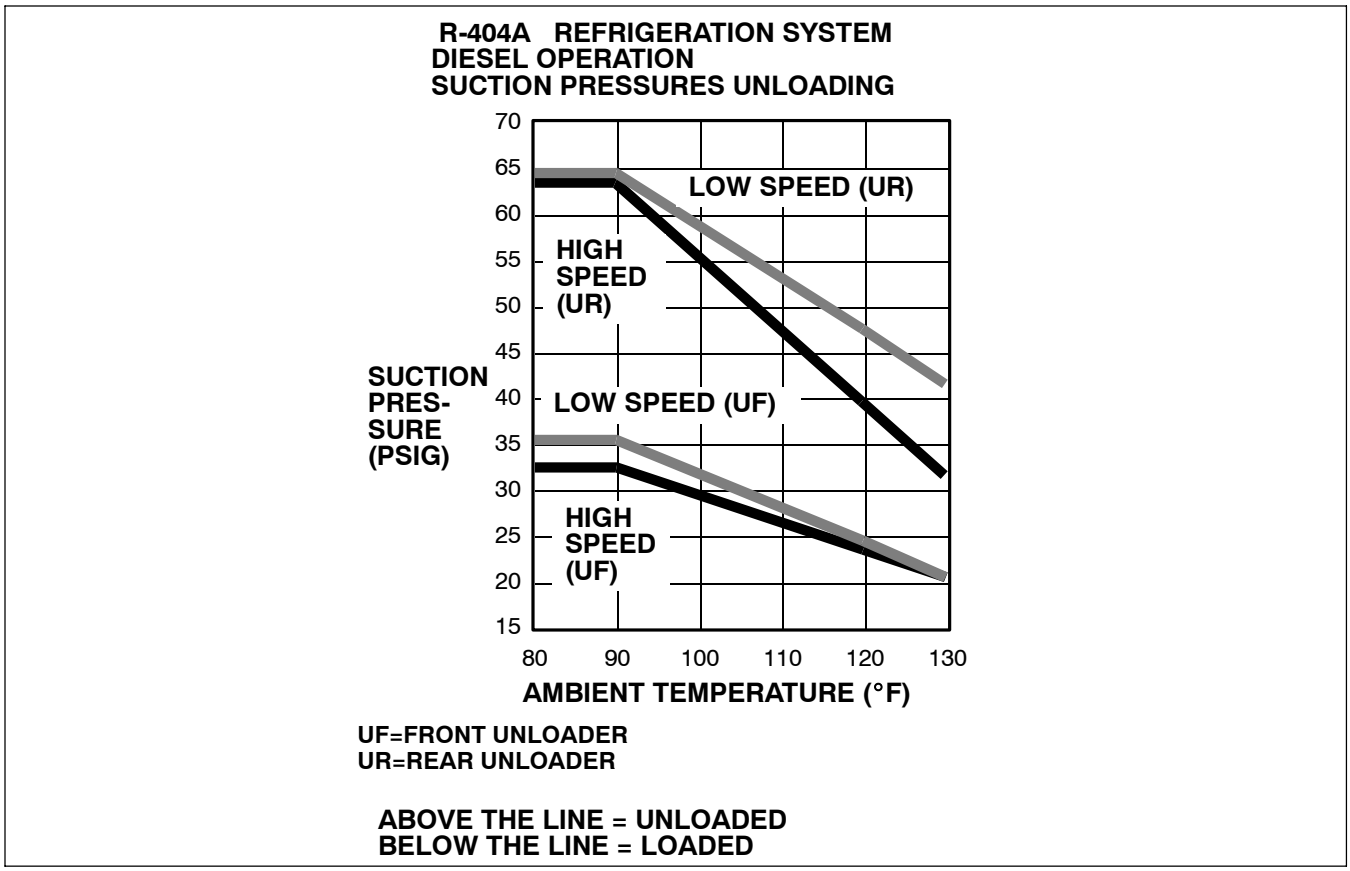
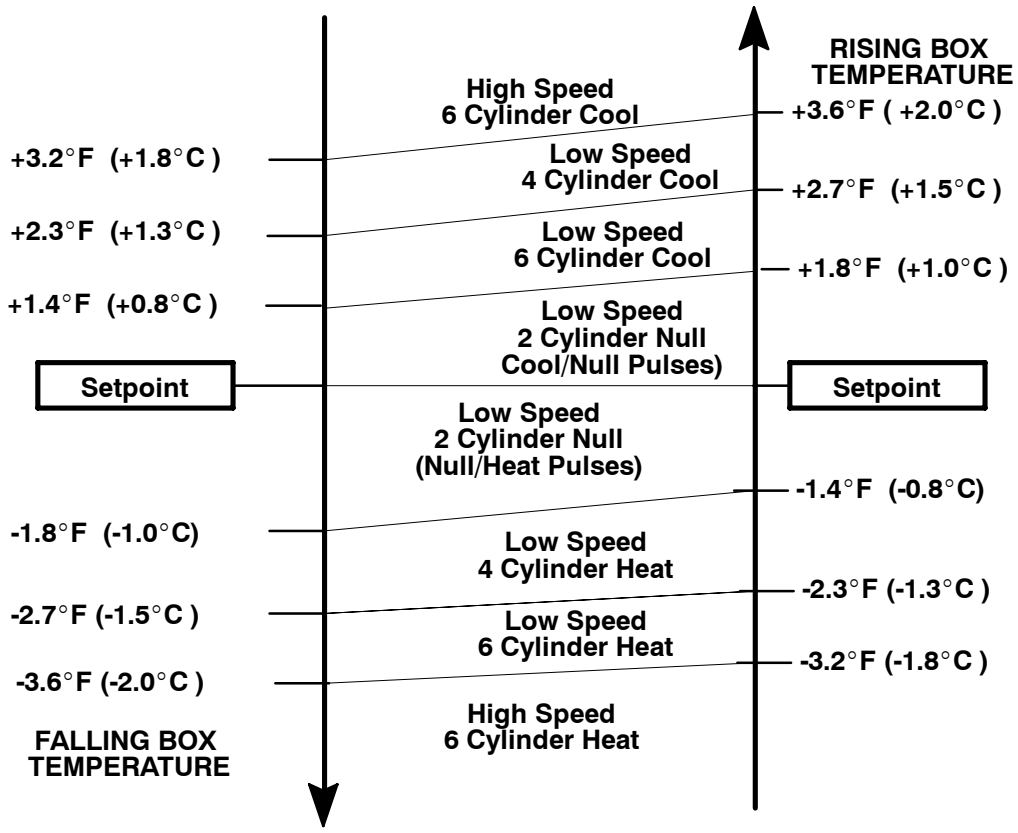


Figure 4-2 – SUCTION PRESSURE UNLOADING

NOTE

The following temperature control operating sequence diagrams are after pulldown and do not show overrides.



Note: The unit follows the temperature control sequence shown in this diagram AFTER pulldown. The sequence does not include any speed or unloader overrides.

Figure 4-3. UltraFresh II Perishable Setpoint - Continuous Run Temperature Control

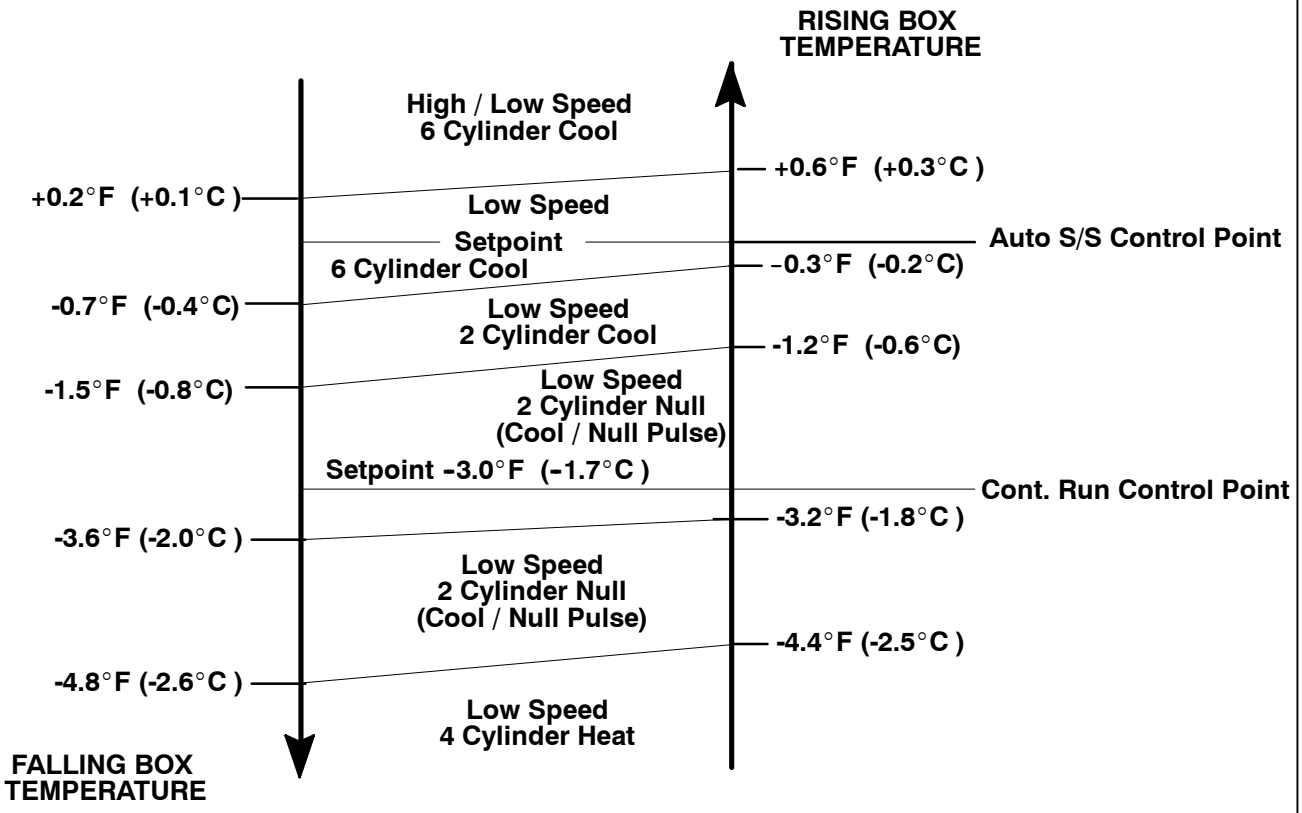


Figure 4-4. UltraFreeze - Start/Stop And Continuous Run Temperature Control

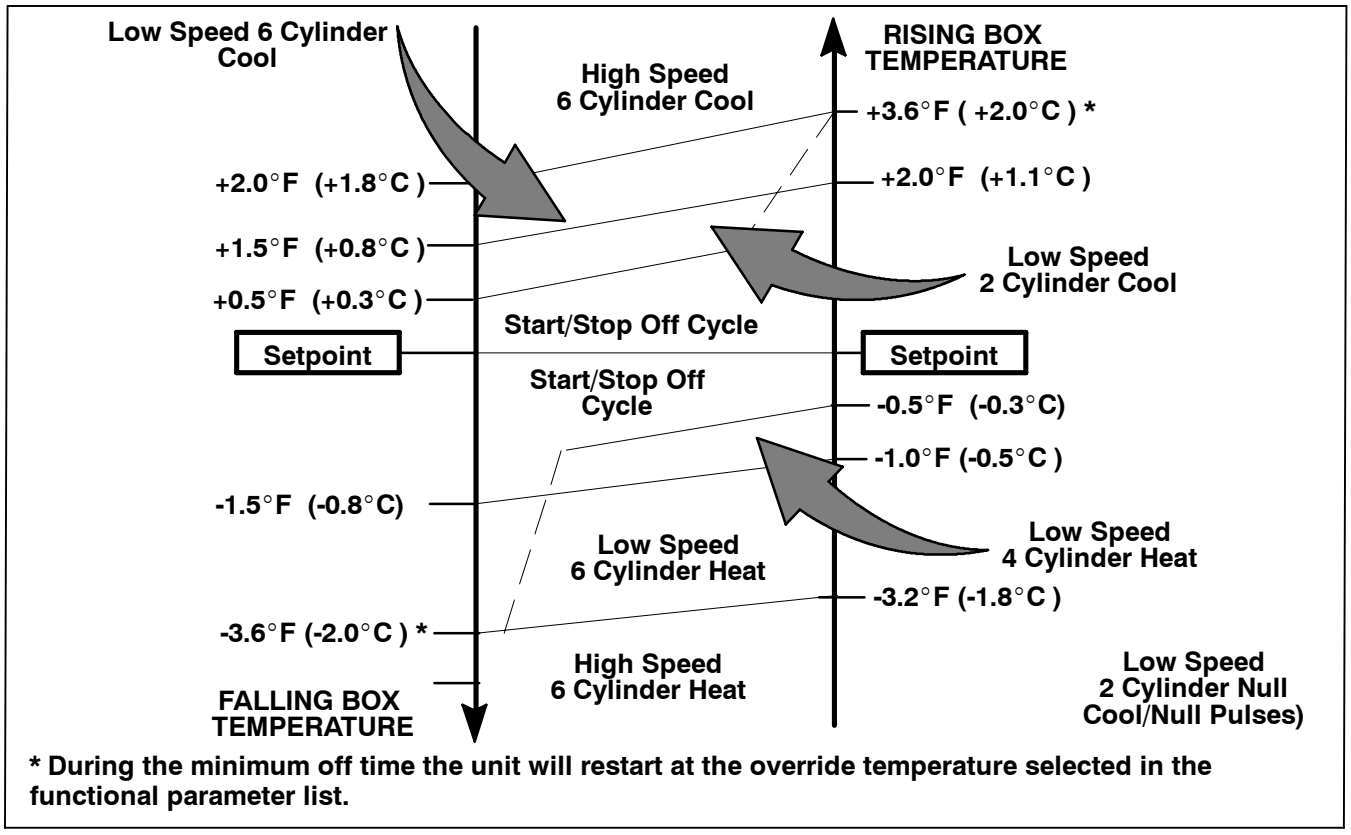

Low Speed 6 Cylinder Cool
RISING BOX TEMPERATURE
High Speed 6 Cylinder Cool
+3.6°F (+2.0°C) *
+2.0°F (+1.8°C)
+2.0°F (+1.1°C)
+1.5°F (+0.8°C)
Low Speed 2 Cylinder Cool
+0.5°F (+0.3°C)
Start/Stop Off Cycle
Setpoint
Setpoint
Start/Stop Off Cycle
-0.5°F (-0.3°C)
-1.0°F (-0.5°C)
-1.5°F (-0.8°C)
Low Speed 4 Cylinder Heat
Low Speed 6 Cylinder Heat
-3.2°F (-1.8°C)
-3.6°F (-2.0°C) *
High Speed 6 Cylinder Heat
Low Speed 2 Cylinder Null Cool/Null Pulses)
FALLING BOX TEMPERATURE
* During the minimum off time the unit will restart at the override temperature selected in the functional parameter list.

Figure 4-5. Start-Stop - Perishable Temperature Control Operating Sequence During Minimum Run Time

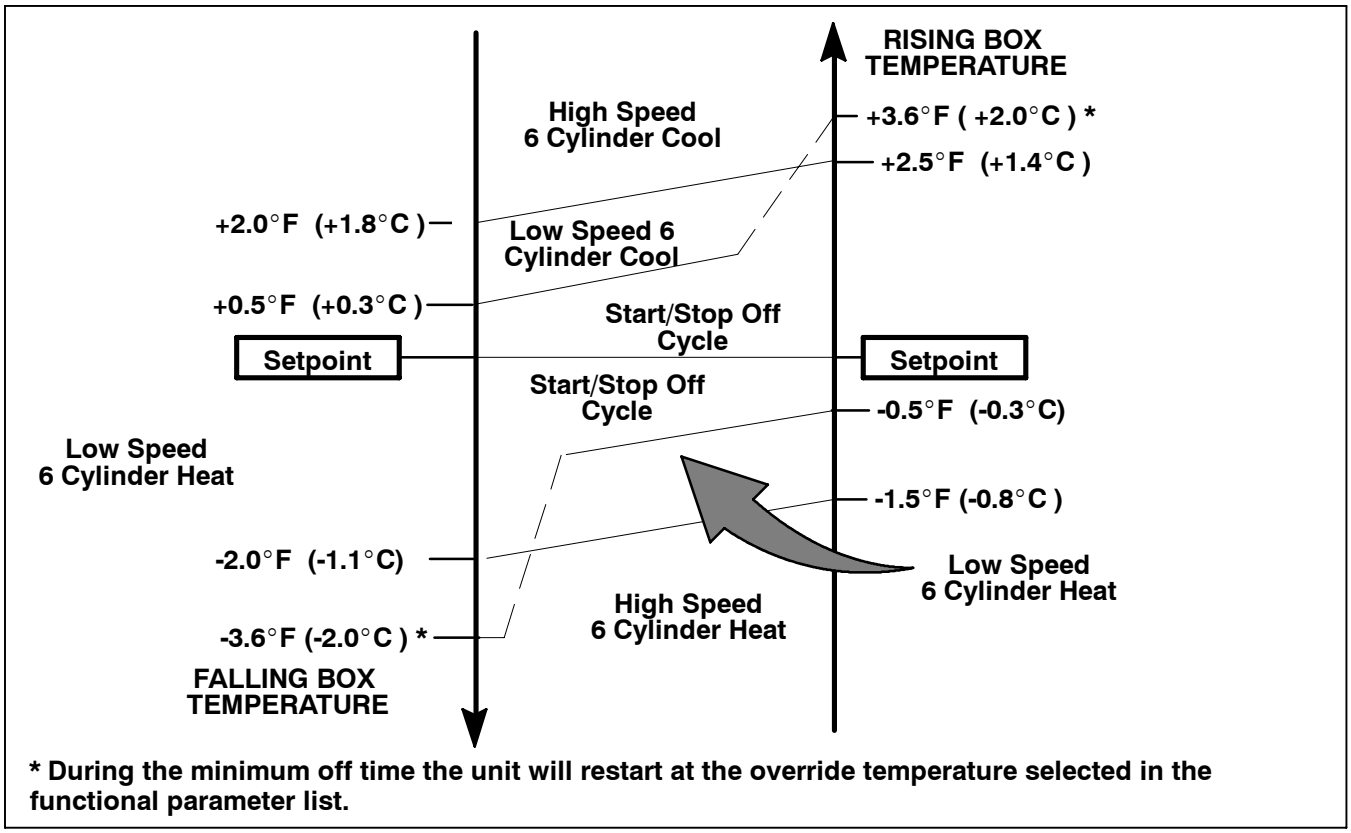

RISING BOX TEMPERATURE
High Speed 6 Cylinder Cool
+3.6°F (+2.0°C) *
+2.5°F (+1.4°C)
+2.0°F (+1.8°C)
Low Speed 6 Cylinder Cool
+0.5°F (+0.3°C)
Start/Stop Off Cycle
Setpoint
Setpoint
Start/Stop Off Cycle
-0.5°F (-0.3°C)
Low Speed 6 Cylinder Heat
-1.5°F (-0.8°C)
Low Speed 6 Cylinder Heat
-2.0°F (-1.1°C)
High Speed 6 Cylinder Heat
-3.6°F (-2.0°C) *
FALLING BOX TEMPERATURE
* During the minimum off time the unit will restart at the override temperature selected in the functional parameter list.

Figure 4-6. Start-Stop - Perishable Temperature Control Operating Sequence After Minimum Run Time

4.3 ULTRAFRESH 2 TEMPERATURE CONTROL (CNF 6 must be set to OFF and CNF 15 must be set to ON)

NOTE

In high ambient temperatures [120°F (48.9°C) and above], the unit will operate only in Low Speed.

UltraFresh 2 temperature control algorithm is a method of producing a reduced capacity state between heat and cool modes. This is done by combining a null pulse with either heat or cool. The capacity in this band can vary by adjusting the duty cycle of the null portion of operation. During this null operation heat and cool valves are opened simultaneously to reduce heating or cooling capacity.

UltraFresh 2 temperature control uses both supply and return air sensors to achieve control. If both probes are present and neither is defective or out of range the selected probe is the active probe. The controlling probe will switch depending on if the unit has pulled down to setpoint yet. During pulldown the controlling temperature is from the active probe. When not in pulldown mode the controlling temperature is supply air plus an integrator error which is based on the selected controlling (active) probe. When not in pulldown mode and the setpoint is greater than or equal to 60°F (15.6°C) the active probe is used for control and integration .

There are three possible modes for UltraFresh 2 control. These are heat, cool and null. To enter COOL the control temperature must be greater than or equal to 1.8° F (1°C) above setpoint. To exit cool and enter NULL the control temperature must be less than 1.4° F (0.8°C) above setpoint. To exit NULL and enter HEAT the control temperature must be more than or equal to 1.8° F (1°C) below setpoint and to exit heat and enter NULL the control temperature must be less than 1.4° F (0.8° C) below setpoint. (See Figure 4-3).

Null mode operates with a pulse, which combines cooling or heating with a null valve combination over a 10 second period (See operation of relays and valves in chart below.) The null valve portion of the period is defined as HR1 and HR4 de-energized and HR2 energized. The system will pulse between Cool and Null when the control temperature is above setpoint, or it will pulse between Heat and Null when the control temperature is below setpoint. The length of time the pulse spends in the Cool or Heat Mode plus the time it spends in the Null Mode will be 10 seconds. The closer the control temperature is to set point, the longer the Null Mode Pulse, and the shorter the Cool or Heat Mode Pulse. At the end of each 10 second period the type of pulse (Cool / Null or Heat / Null) and percentage of time for each is recalculated.

When in the null mode: The HEAT and COOL LCDs on the microprocessor display will blank out. The heat and cool lights (on 8–light bar) will flash back and forth every 10 seconds or so.

UltraFresh 2 only operates when: Setpoint is in the perishable range above10°F (–12°C) and the unit is set for continuous run operation.

There is a delay of 10 seconds between de-energizing one unloader to de-energizing the other unloader under all operating conditions excluding engine starting.

• Cool Pulsed Mode

SV1	SV2	SV4	Engine Speed	UL1	UL2
OPEN	OPEN	CLOSED	LOW	UNLOAD	UNLOAD

• Null Pulsed Mode

SV1	SV2	SV4	Engine Speed	UL1	UL2
OPEN	OPEN	OPEN	LOW	UNLOAD	UNLOAD

• Heat Pulsed Mode

SV1	SV2	SV4	Engine Speed	UL1	UL2
CLOSED	OPEN / CLOSED BY HP2	OPEN	LOW	UNLOAD	UNLOAD

4.4 ULTRA FREEZE TEMPERATURE CONTROL (CNF 6 must be set to OFF and CNF5 and CNF 17 must be set to ON)

NOTE

In high ambient temperatures [120°F (48.9°C) and above], the unit will operate only in Low Speed.

For frozen setpoints, a modified UltraFresh 2 temperature control is used to keep the unit from over cooling and driving the box temperature far below setpoint. UltraFreeze operates the same as UltraFresh 2 except as noted in this section. UltraFreeze control will be used anytime a frozen setpoint is selected in both diesel and standby units, in both continuous and start/stop operation. When in standard multi-temp temperature control UltraFreeze is used to control the main compartment if it has a frozen setpoint selected. UltraFreeze operates independently of the setting of CNF-15.

If UltraFreeze is active the Ultra Fresh 2 unloader cooling logic is not invoked.

4.4.1 Ultra Freeze Offset

In continuous run a -3°F (-2.4°C) offset is added which will force the unit to control to 3°F (-2.4°C) below setpoint. When the unit demands high speed cool and the high speed is delayed the unit will be allowed to run 6 cylinder low speed cool.

4.4.2 Ultra Freeze Start/Stop

In start/stop operation the unit's control will not have the 3°F offset and will control to setpoint by cycling the unit on and off according to the standard frozen mode start/-stop startup and shutdown logic. The exception to this is when a low battery voltage or low engine coolant temperature defeats the normal shutdown logic, then the Ultra Freeze logic will control to the 3°F below setpoint offset.

4.4.3 Default Mode

When no controlling probe is available, the unit will enter default mode for standard temperature control. When in frozen range [setpoint is less than or equal to 10.4° F (-12.0° C)] the unit will default to low speed loaded. When in perishable range [setpoint is greater than or equal to 10.4° F (-12.0° C)], the unit will shut down.

4.5 OVERRIDES

4.5.1 SPEED SOLENOID OVERRIDES

When the ambient temperature is 120°F (48.9°C) or above, the unit will operate in Low Speed only.

4.5.2 UNLOADER OPERATION OVERRIDES (CNF 19 Must be set to ON)

- When ambient temperature is below 110°F (43.3°C), the rear unloader (UR) is forced loaded for pulldown regardless of suction pressure.
- When ambient temperature is above 125°F (51.7°C), the rear unloader (UR) is allowed to unload and standard unloader logic is applied.
- When ambient temperature is between 110°F and 125°F (43.3°C and 51.7°C), the rear unloader (UR) will only be allowed to unload during the first 30 seconds of engine run time, thereafter it will be forced loaded regardless of suction pressure.

SECTION 5 - TROUBLESHOOTING

⚠ CAUTION

Under no circumstances should anyone attempt to service the microprocessor!(See Section 6.31) Should a problem develop with the microprocessor, contact your nearest Carrier Transicold dealer for replacement.

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.1 DIESEL ENGINE		
5.1.1 Engine Will Not Start		
Starter motor will not crank or low cranking speed	Battery insufficiently charged	Check
	Battery terminal post dirty or defective	Check
	Bad electrical connections at starter	Check
	Starter motor malfunctions	5.1.3
	Starter motor solenoid defective	Engine Manual
	Open starting circuit	5.1.4
	Incorrect grade of lubricating oil	2.8
	Oil pressure switch contacts closed	Check
	Voltage at D+ with engine not running	2.3.2
	Water or oil on top of pistons	Check
	Compressor not turning freely	Check
Starter motor cranks but engine fails to start	No fuel in tank	Check
	Air in fuel system	6.7
	Water in fuel system	Drain Sump
	Plugged fuel filters	Replace
	Plugged fuel lines to injector (s)	Check
	Fuel control operation erratic	Engine Manual
	Glow plug(s) defective	6.10.7
	Fuel solenoid defective	Engine Manual
	Fuel pump (FP) malfunction	6.7
	Restricted air filter	6.10.5
	Problem with ENSCU system	5.4
	Fuel pump screen plugged	Replace
Starter cranks, engages, but dies after a few seconds	Engine lube oil too heavy	2.8
	Loose connection at battery	Check
	Poor/corroded battery cable ends	Check
	Compressor not turning freely	Check

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.1.2 Engine Starts Then Stops		
Engine stops after several rotations	Fuel supply restricted No fuel in tank Leak in fuel system Faulty fuel control operation Fuel filter restricted Injector nozzle(s) defective Injection pump defective Air cleaner or hose restricted Safety device open – Check alarms Stop/Fuel solenoid defective Fuel pump (FP) malfunction Problem with ENSCU system Air in fuel system	Check Check Check Engine Replace Engine Manual Engine Manual 6.10.5 2.13 and Table 3-3 Replace 6.7 5.4 6.7
Starter motor will not crank or turns slowly	Battery insufficiently charged Battery cable connections loose or oxidized Battery cables defective Starter brushes shorted out Starter brushes hang up or have no contact Starter solenoid damaged Run-Stop switch defective Engine lube oil too heavy	Check Check Replace Engine Manual Engine Manual Engine Manual Replace 2.8
5.1.3 Starter Motor Malfunction		
Starter motor turns but pinion does not engage	Pinion or ring gear obstructed or worn Starter clutch not engaging	Clean both, remove burrs, or replace; apply grease Repair or replace
Starter motor does not disengage after switch was released	Glow/Crank switch defective (If equipped) Starter motor solenoid defective	Replace Engine Manual
Pinion does not disengage after engine is running	Defective starter	Engine Manual
5.1.4 Malfunction In the Engine Starting Circuit		
No power to starter motor solenoid (SS)	Battery defective Loose electrical connections Defective starter solenoid relay (SSR) Defective Glow/Crank switch (if equipped) Voltage at D+ on alternator	Check Tighten Check Check 2.3.2
Stop/Fuel solenoid does not energize or does not remain energized	Battery defective Loose electrical connections Oil pressure safety switch (OP) defective Run relay (RR) defective Water temperature sensor (WTS) defective Stop/Fuel solenoid defective Run-Stop switch defective	Check Tighten Replace Replace Replace Replace Replace

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.2 ALTERNATOR		
Alternator fails to charge	Limited charging system operating time Battery condition Alternator belt loose/broken Loose, dirty, corroded terminals, or broken wires Excessively worn, open or defective brushes Regulator faulty Ammeter faulty Alternator faulty	Check Check 6.11 Check/Repair Check Check Replace Replace
Low or unsteady charging rate	Alternator belt loose/broken Loose, dirty, corroded terminals, or broken wires Excessively worn, sticky or intermittent brushes Faulty regulator Alternator faulty Ammeter wires loose Ammeter faulty	6.11 Check/Repair Check Check Replace Check and Tighten Replace
Excessive charging rate (as evidenced by battery requiring too frequent refilling) or charge indicator shows constant “charge with engine idling”	Regulator leads loose, dirty, corroded terminals, or wires broken Defective regulator Defective battery	Clean/Repair Check Replace
Noisy alternator	Defective or badly worn V-belt Worn bearing(s) Misaligned belt or pulley Loose pulley	6.11 Replace 6.11 Tighten
5.3 REFRIGERATION		
NOTE: All Refrigeration System problems should be investigated by following the Quick Check Refrigeration System Troubleshooting Procedure (Refer to Section 6.13).		
5.3.1 Unit Will Not Cool		
Diesel engine	Malfunctions – Not running	5.1
Compressor malfunction	Compressor drive defective Compressor defective Compressor unloaders not working Compressor reed valves or valve plate gaskets defective	6.18 6.18 6.20.1 Replace
Refrigeration system	Defrost cycle did not terminate Abnormal pressure Solenoid valve malfunction Clutch Failure	5.3.5 5.3.6 5.3.11 Check

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.3.2 Unit Runs But Has Insufficient Cooling		
Compressor	Compressor valves defective Unloader malfunction	6.20.1 6.20.1
Refrigeration system	Abnormal pressure Unloader malfunction Expansion valve malfunction No or restricted evaporator airflow Clutch Failure Low refrigerant level	5.3.6 6.20.1 5.3.10 5.3.9 Replace 6.13.1
Engine does not develop full rpm	Speed control linkage (units with non ESC engines) Engine malfunction Refrigerant pressure	6.10.3 5.1 5.3.6
5.3.3 Unit Operates Long or Continuously in Cooling		
Trailer	Hot Load Defective box insulation or air leak or door is open	Allow time to pull down Correct
Refrigeration system	Abnormal pressure Temperature controller malfunction (micro) Refrigerant charge Solenoid valve malfunction Fanshaft seal leaking	5.3.6 5.3.8 6.13.1 Perform quick check (6.13) Repair
Compressor	Defective Compressor valves defective Unloader malfunction	6.18 6.20.1 6.20
5.3.4 Unit Will Not Heat or Has Insufficient Heating		
Refrigeration	Head pressure control switch (HP-2) defective Abnormal pressure Temperature controller malfunction Solenoid valve malfunction 1/4” check valve (bypass) defective Clutch Failure Low refrigerant level SV1 malfunction SV4 malfunction	6.24 5.3.6 5.3.8 5.3.11 6.13.4 Check 6.13.1 6.26.2 6.26.1
Compressor	Compressor drive defective Compressor defective Unloader/Compressor gaskets or valves defective	6.18 6.18 6.20.1
Engine does not develop full rpm	Speed control linkage (units with non ESC engines) Engine malfunction	6.10.3 5.1

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.3.5 Defrost Cycle Malfunction		
Will not initiate defrost automatically	Defrost air switch (DA) out of calibration Defrost thermostats (DTT) open or defective DTT not properly installed in correct location Defrost air switch (DA) defective Loose defrost air switch connections Air sensing tubes defective or disconnected	6.28 Replace Repair Replace Tighten Check/Repair
Will not initiate defrost manually	Microprocessor defective Loose terminal connections Defrost thermostats (DTT) or circuit open or defective Keypad defective	Replace Tighten Replace or Repair Replace
Initiates but does not defrost	Solenoid valve malfunction, SV-1, SV-4 Defrost relay (DR) defective Clutch/Gearbox defective Low refrigerant level HP2 malfunction	5.3.11 Replace Replace 6.13.1 Replace
Frequent defrost	Defrost air switch (DA) out of adjustment Wet load Trailer doors open or there is an air leak Fanshaft seal leaking	6.28 Normal Close Doors Repair
Does not terminate or cycles on defrost	Defrost thermostats (DTT) shorted closed Head pressure control switch (HP-2) defective Low refrigerant level Defrost air switch (DA) out of adjustment or shorted Solenoid SV1 not closing DTT not properly installed in correct location	Replace 6.24 6.15 & 6.17 6.28 Replace Repair

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.3.6 Abnormal Pressure 5.3.6.1 Cooling		
High discharge pressure	Condenser coil dirty Condenser fan defective V-belt broken or loose Discharge check valve restricted or other high side restriction Noncondensibles in refrigeration system Solenoid valve (SV-1) malfunction Refrigerant level is over full	6.30 Replace 6.11 Check & 6.21 6.16 6.26.2 6.13.1
Low discharge pressure	Compressor valves(s) worn or broken Low refrigerant level Solenoid valve malfunction	6.20.1 6.15 & 6.17 Replace
High suction pressure	Compressor valves(s) worn or broken Compressor gasket(s) defective Solenoid or unloader valve malfunction SV-4 defective	6.20.1 Replace Replace 6.26
Low suction pressure	Suction service valve partially closed King valve partially closed Filter-drier partially plugged Low refrigerant level Expansion valve malfunction No evaporator air flow or restricted air flow Excessive frost/ice on coil Solenoid valve (SV-2) defective Clutch Failure	Open Open 6.22 6.15 & 6.17 5.3.10 5.3.9 Check 6.26 Replace
Suction and discharge pressures tend to equalize when unit is operating	Compressor valves defective Compressor drive defective	6.20.1 Replace

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.3.6.2 Heating		
High discharge pressure	Solenoid valves (SV-1, SV–2 or SV-4) malfunction V-belts broken or loose Noncondensibles in system Head pressure control switch (HP-2) defective (closed) Refrigerant level is over full	5.3.11 6.11 Check 6.24 6.13.1
Low discharge pressure	Compressor valve(s) worn or broken Head pressure control switch (HP-2) defective(open) Solenoid valve (SV-1) malfunction Low refrigerant charge Bypass check valve defective	6.20.1 6.24 5.3.11 6.15 & 6.17 Replace
Low suction pressure	Low Refrigerant level Solenoid (SV-1) open Head pressure control switch (HP-2) defective (open) Bypass check valve defective	6.15 & 6.17 5.3.11 6.24 Replace
5.3.7 Abnormal Noise		
Compressor	Loose mounting bolts Worn bearings Worn or broken valves Liquid slugging Insufficient oil Drive adaptor loose or defective	Tighten 6.18 6.20.1 5.3.10 6.19 Tighten or re-place
Condenser or evaporator fan	Loose or striking shroud Bearings defective Bent shaft	Check Replace Replace
Clutch/Gearbox	Defective	Replace
V-belts	Cracked or worn	6.11
5.3.8 Control System Malfunction		
Will not control	Sensor(s) defective or incorrectly mounted Relay(s) defective Microprocessor controller malfunction Bulkhead is damaged or incorrect for application	Check & 6.33 Check 6.31 Replace
5.3.9 No Evaporator Air Flow or Restricted Air Flow		
Evaporator coil blocked	Frost on coil Dirty coil Debris (shrinkwrap) caught behind bulkhead Return air bulkhead is not in good condition or is attached incorrectly or is not correct for application	Check 6.29 Clean Check/Replace
No or partial evaporator air flow	V-belt broken or loose Clutch/Gearbox defective Evaporator fan loose or defective Evaporator air flow blocked in trailer (box) Debris (shrinkwrap/cardboard) caught in bulkhead Air chute is not in good condition or is attached incorrectly	6.11 Replace Check Check Clean Check/Replace

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
5.3.10 Expansion Valve Malfunction		
Low suction pressure and/or high superheat	Low refrigerant charge External equalizer line plugged Ice formation at valve seat Wax, oil or dirt plugging valve or orifice Broken capillary tube on TXV Power Assy failure or partial loss of element/bulb charge Superheat setting too high (Defective TXV) King valve partially closed Filter drier is restricted	6.15 & 6.17 Clean 6.16 6.23 Replace Replace Replace Open 6.22
Low superheat and liquid slugging in compressor	Superheat setting too low External equalizer line plugged Ice holding valve open Foreign material in valve Pin and seat of expansion valve eroded or held open by foreign material Heat exchanger is leaking internally	6.23.2 Open 6.16 Clean 6.23 Replace
Fluctuating suction pressure	Improper TXV bulb location or installation Low TXV superheat setting Incorrect TXV is installed	6.23 6.23 Replace
5.3.11 Solenoid Valve Malfunction		
Solenoid valve does not function properly	No power to valve Improper wiring or loose connections Coil defective Valve improperly assembled Coil or coil sleeve improperly assembled Movement of plunger restricted due to: a. Corroded or worn parts b. Foreign material lodged in valve c. Bent or dented enclosing tube Defective HR (1,2,3)	Check Check 6.26 6.26 6.26 6.26 6.26 6.26 Replace
Solenoid valve closes but refrigerant continues to flow	Foreign material lodged under seat Defective seat	Clean Replace

5.4 Electronic Speed Control Troubleshooting

Table 5-1. ENSCU LED Fault Chart (See following pages for troubleshooting trees)

The following diagnostic tables are intended to assist technicians in diagnosing problems with Electronic Speed Control Engine Units. These tables are not intended to replace a good technician's knowledge of the control and electrical systems, but to supplement it.

It is important to verify the reported LED alarm and then correctly identify the appropriate table for that condition.

When using these tables, do not skip any steps. The tables are formatted in a logical troubleshooting sequence and skipping around the tables will most likely lead to errors in diagnosis.

A few testing procedures call for the use of a jumper wire. This is necessary due to the tight fit of the pins when seated in the connecter. Crimp female terminal (CTD P/N 22-50098-61A) to one end of a 2" piece of wire and leave the other end of the wire bare in order to check for proper voltages and resistances as outline in the tables.

	Fault	LED display pattern	Failed component
1	Engine Over Speed: more than 2,530 RPM	One Long–One Short	ENSSN or mechanical engine problem
2	No signal from ENSSN for 2 seconds after RPM is greater than 1,000 RPM for 10 seconds, **OR** for 5 seconds while engine cranking (no voltage at pin 18 of ENSCU).	Two Long–One Short	ENSSN or wiring problem
3	Actuator (FSA) wiring disconnected or open circuit. Coil Resistance Spec: 2.8 ohm +/- 10%.	Two Long–Three Short	FSA or wiring problem
4	ENSCU supply voltage is greater than 26V.	Two Long–Seven Short	ENSCU or alternator problem

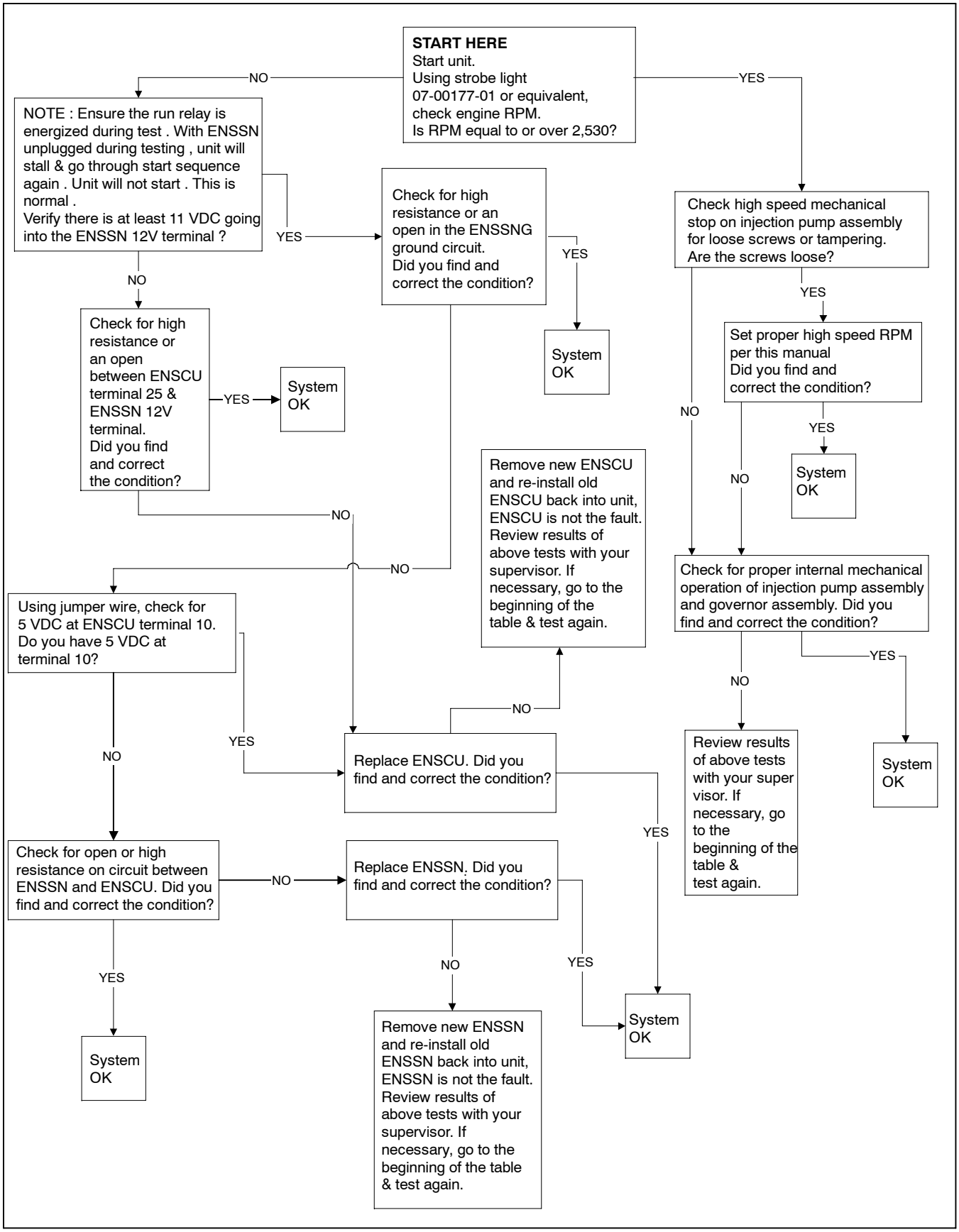

START HERE
Start unit.
Using strobe light
07-00177-01 or equivalent,
check engine RPM.
Is RPM equal to or over 2,530?
NO
YES
NOTE : Ensure the run relay is energized during test . With ENSSN unplugged during testing , unit will stall & go through start sequence again . Unit will not start . This is normal .
Verify there is at least 11 VDC going into the ENSSN 12V terminal ?
YES
NO
Check for high resistance or an open in the ENSSNG ground circuit.
Did you find and correct the condition?
YES
System OK
Check for high resistance or an open between ENSCU terminal 25 & ENSSN 12V terminal.
Did you find and correct the condition?
YES
System OK
NO
NO
Check high speed mechanical stop on injection pump assembly for loose screws or tampering.
Are the screws loose?
YES
Set proper high speed RPM per this manual
Did you find and correct the condition?
YES
System OK
NO
NO
Remove new ENSCU and re-install old ENSCU back into unit, ENSCU is not the fault. Review results of above tests with your supervisor. If necessary, go to the beginning of the table & test again.
Check for proper internal mechanical operation of injection pump assembly and governor assembly. Did you find and correct the condition?
YES
NO
Review results of above tests with your super visor. If necessary, go to the beginning of the table & test again.
System OK
Using jumper wire, check for 5 VDC at ENSCU terminal 10.
Do you have 5 VDC at terminal 10?
NO
YES
NO
Replace ENSCU. Did you find and correct the condition?
YES
Check for open or high resistance on circuit between ENSSN and ENSCU. Did you find and correct the condition?
NO
Replace ENSSN. Did you find and correct the condition?
YES
NO
YES
System OK
Remove new ENSSN and re-install old ENSSN back into unit, ENSSN is not the fault. Review results of above tests with your supervisor. If necessary, go to the beginning of the table & test again.
System OK

Figure 5–1. ESC Diagnostic Tree – 1 Long, 1 Short LED Code (Engine RPM is Over 2530 RPM)

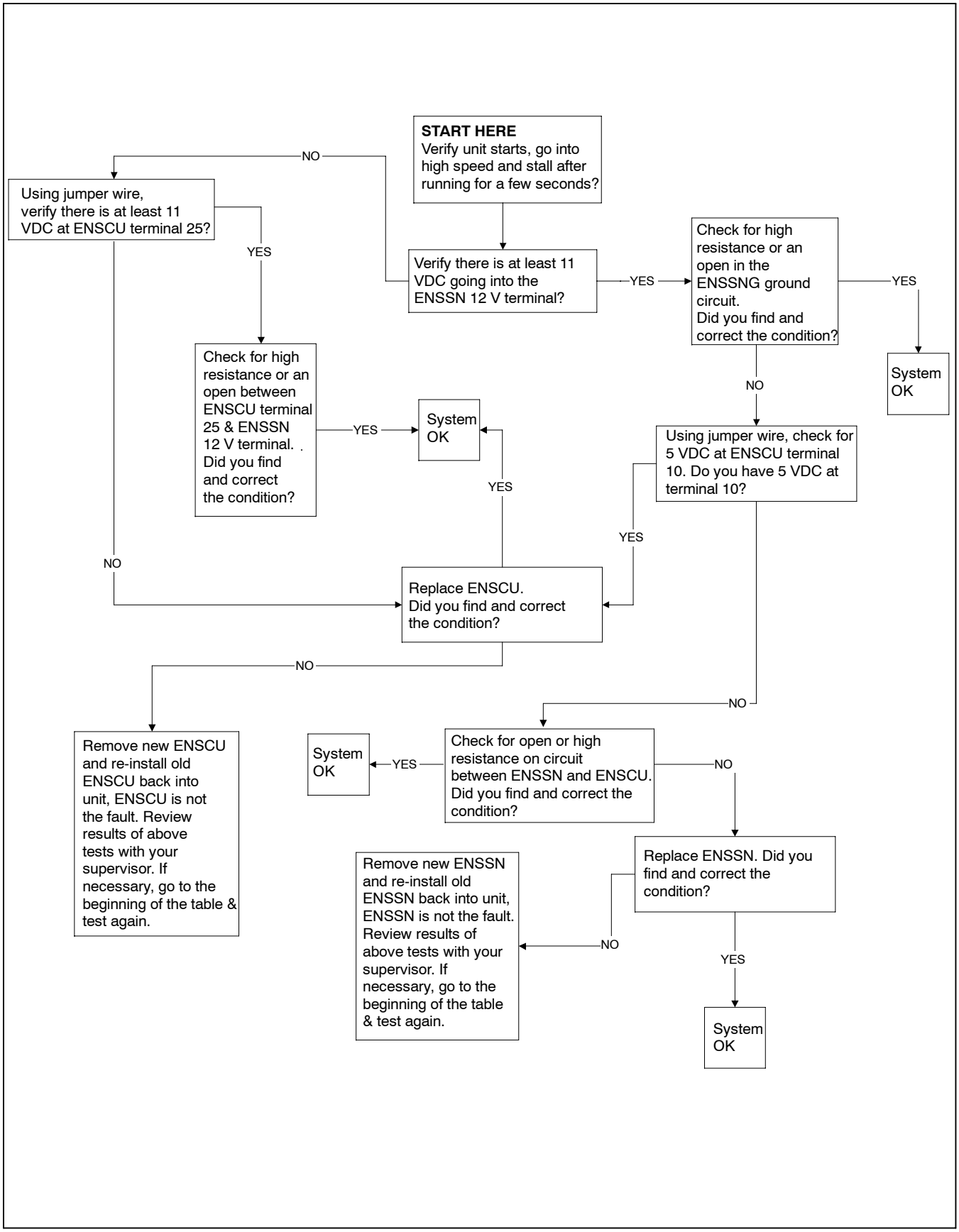

START HERE
Verify unit starts, go into high speed and stall after running for a few seconds?
NO
Using jumper wire, verify there is at least 11 VDC at ENSCU terminal 25?
YES
Verify there is at least 11 VDC going into the ENSSN 12 V terminal?
YES
Check for high resistance or an open in the ENSSNG ground circuit. Did you find and correct the condition?
YES
System OK
NO
Check for high resistance or an open between ENSCU terminal 25 & ENSSN 12 V terminal. Did you find and correct the condition?
YES
System OK
YES
Using jumper wire, check for 5 VDC at ENSCU terminal 10. Do you have 5 VDC at terminal 10?
YES
NO
Replace ENSCU. Did you find and correct the condition?
NO
Remove new ENSCU and re-install old ENSCU back into unit, ENSCU is not the fault. Review results of above tests with your supervisor. If necessary, go to the beginning of the table & test again.
NO
Check for open or high resistance on circuit between ENSSN and ENSCU. Did you find and correct the condition?
YES
System OK
NO
Replace ENSSN. Did you find and correct the condition?
YES
System OK
NO
Remove new ENSSN and re-install old ENSSN back into unit, ENSSN is not the fault. Review results of above tests with your supervisor. If necessary, go to the beginning of the table & test again.

Figure 5-2. ESC Diagnostic Tree – 2 Long, 1 Short LED Code (FSA Electrical Failure)

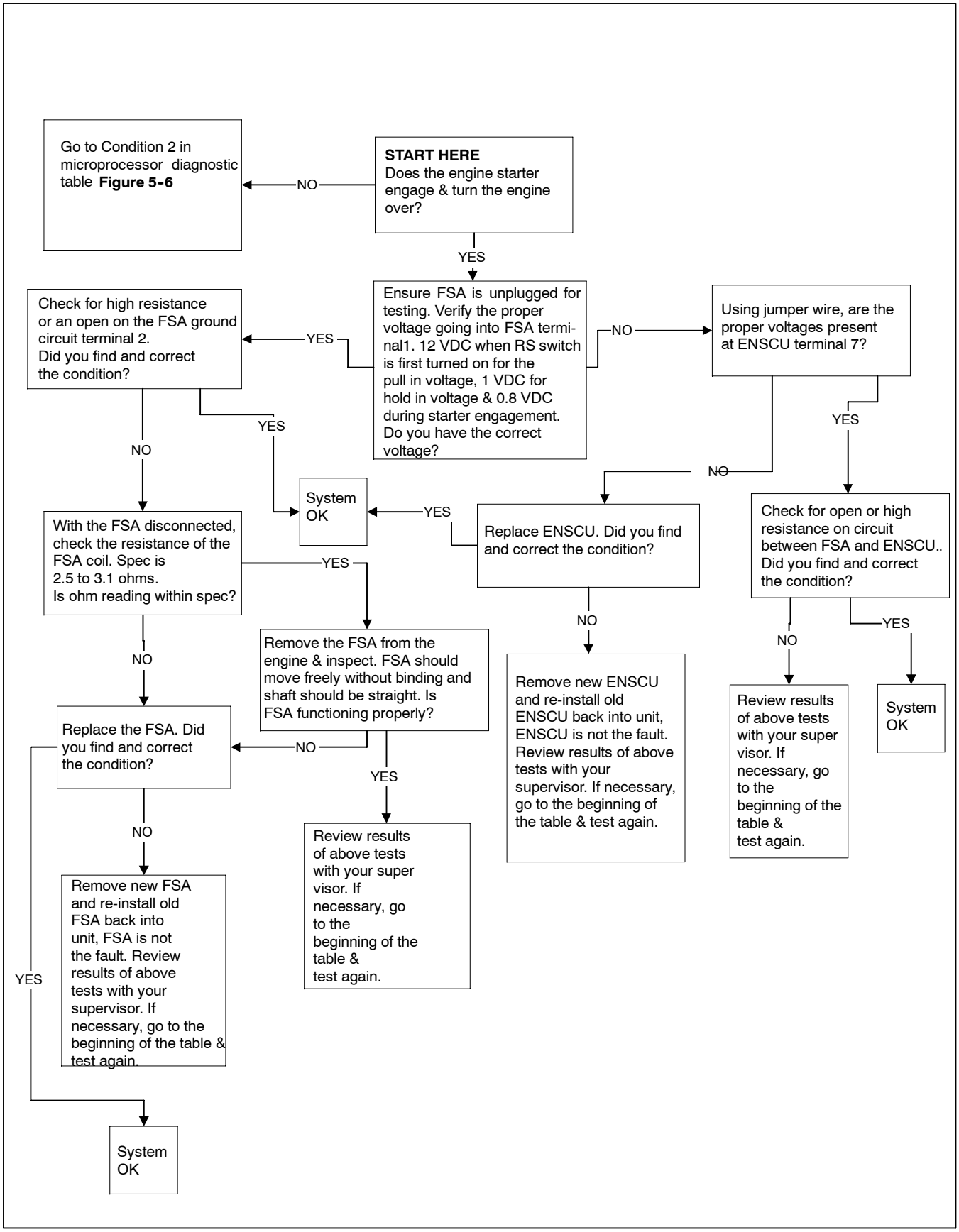

START HERE
Does the engine starter engage & turn the engine over?
NO
Go to Condition 2 in microprocessor diagnostic table **Figure 5-6**
YES
Ensure FSA is unplugged for testing. Verify the proper voltage going into FSA terminal1. 12 VDC when RS switch is first turned on for the pull in voltage, 1 VDC for hold in voltage & 0.8 VDC during starter engagement. Do you have the correct voltage?
YES
Check for high resistance or an open on the FSA ground circuit terminal 2. Did you find and correct the condition?
NO
Using jumper wire, are the proper voltages present at ENSCU terminal 7?
YES
NO
Replace ENSCU. Did you find and correct the condition?
YES
System OK
YES
Check for open or high resistance on circuit between FSA and ENSCU.. Did you find and correct the condition?
NO
YES
With the FSA disconnected, check the resistance of the FSA coil. Spec is 2.5 to 3.1 ohms. Is ohm reading within spec?
YES
NO
Remove new ENSCU and re-install old ENSCU back into unit, ENSCU is not the fault. Review results of above tests with your supervisor. If necessary, go to the beginning of the table & test again.
Review results of above tests with your super visor. If necessary, go to the beginning of the table & test again.
System OK
Remove the FSA from the engine & inspect. FSA should move freely without binding and shaft should be straight. Is FSA functioning properly?
NO
YES
Replace the FSA. Did you find and correct the condition?
NO
YES
Review results of above tests with your super visor. If necessary, go to the beginning of the table & test again.
NO
Remove new FSA and re-install old FSA back into unit, FSA is not the fault. Review results of above tests with your supervisor. If necessary, go to the beginning of the table & test again.
YES
System OK

Figure 5-3. ESC Diagnostic Tree – 2 Long, 3 Short LED Code (No Speed Sensor Input To ENSCU)

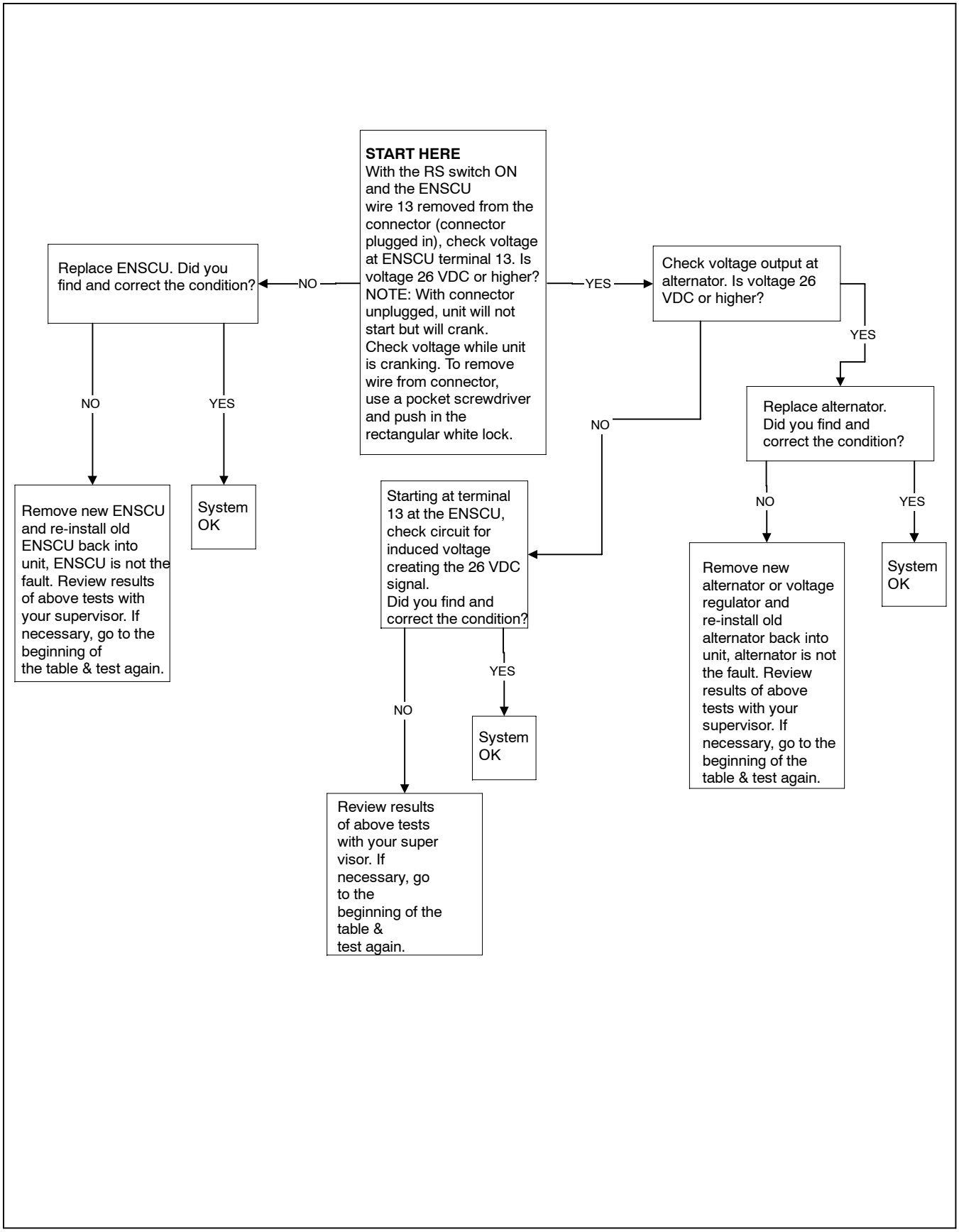

START HERE
With the RS switch ON and the ENSCU wire 13 removed from the connector (connector plugged in), check voltage at ENSCU terminal 13. Is voltage 26 VDC or higher?
NOTE: With connector unplugged, unit will not start but will crank. Check voltage while unit is cranking. To remove wire from connector, use a pocket screwdriver and push in the rectangular white lock.
NO
YES
Replace ENSCU. Did you find and correct the condition?
NO
YES
Remove new ENSCU and re-install old ENSCU back into unit, ENSCU is not the fault. Review results of above tests with your supervisor. If necessary, go to the beginning of the table & test again.
System OK
Check voltage output at alternator. Is voltage 26 VDC or higher?
YES
NO
Replace alternator. Did you find and correct the condition?
NO
YES
Remove new alternator or voltage regulator and re-install old alternator back into unit, alternator is not the fault. Review results of above tests with your supervisor. If necessary, go to the beginning of the table & test again.
System OK
Starting at terminal 13 at the ENSCU, check circuit for induced voltage creating the 26 VDC signal. Did you find and correct the condition?
YES
NO
System OK
Review results of above tests with your super visor. If necessary, go to the beginning of the table & test again.

Figure 5-4. ESC Diagnostic Tree – 2 Long, 7 Short LED Code (ENSCU voltage is over 26 VDC)

5.4.1 Microprocessor Troubleshooting Guide

The following diagnostic tables are intended to assist technicians in diagnosing problems with the standard microprocessor. These tables are not intended to replace a good technician's knowledge of the control and electrical systems, but to supplement it.

When using these tables, it is important to verify the reported symptom or problem and then correctly identify the appropriate table for that particular condition. Using the incorrect table will lead to an incorrect diagnosis.

When using these Diagnostic Tables, it is very important not to skip any steps. Follow the flow of the tables in the order that they are laid out. These tables are formatted into a logical troubleshooting sequence. Skipping around the tables will most likely lead to errors in diagnosis.

Throughout the tables, the steps will point the technician to areas to look at or check for a problem. Most of the steps will lead the technician to a circuit or other area of the unit to check, test, and possibly repair other than the microprocessor. Some steps will point to a possible problem with the microprocessor. Whenever reaching one of these steps, it is a very good practice to install the new microprocessor, then verify unit operation PRIOR TO writing hours into the new microprocessor. Once the technician is satisfied that a new microprocessor is required, the hours should be entered. Should the problem remain even with the new microprocessor in place, once all repairs are made, the original microprocessor is to be reinstalled into the unit, to avoid unnecessary costs to the customer or having the Warranty Request rejected if there is no problem found with the returned microprocessor.

All steps leading to replacement of the microprocessor have a number associated with them. When filling out the MPR tag that will be attached to the returned part, write the step number on the upper half of the tag in the Failure Description Field. Include the same information in the Failure Description Field when entering the warranty claim information on line. This will show which diagnostic table was used and the path that was followed to determine the micro was at fault.

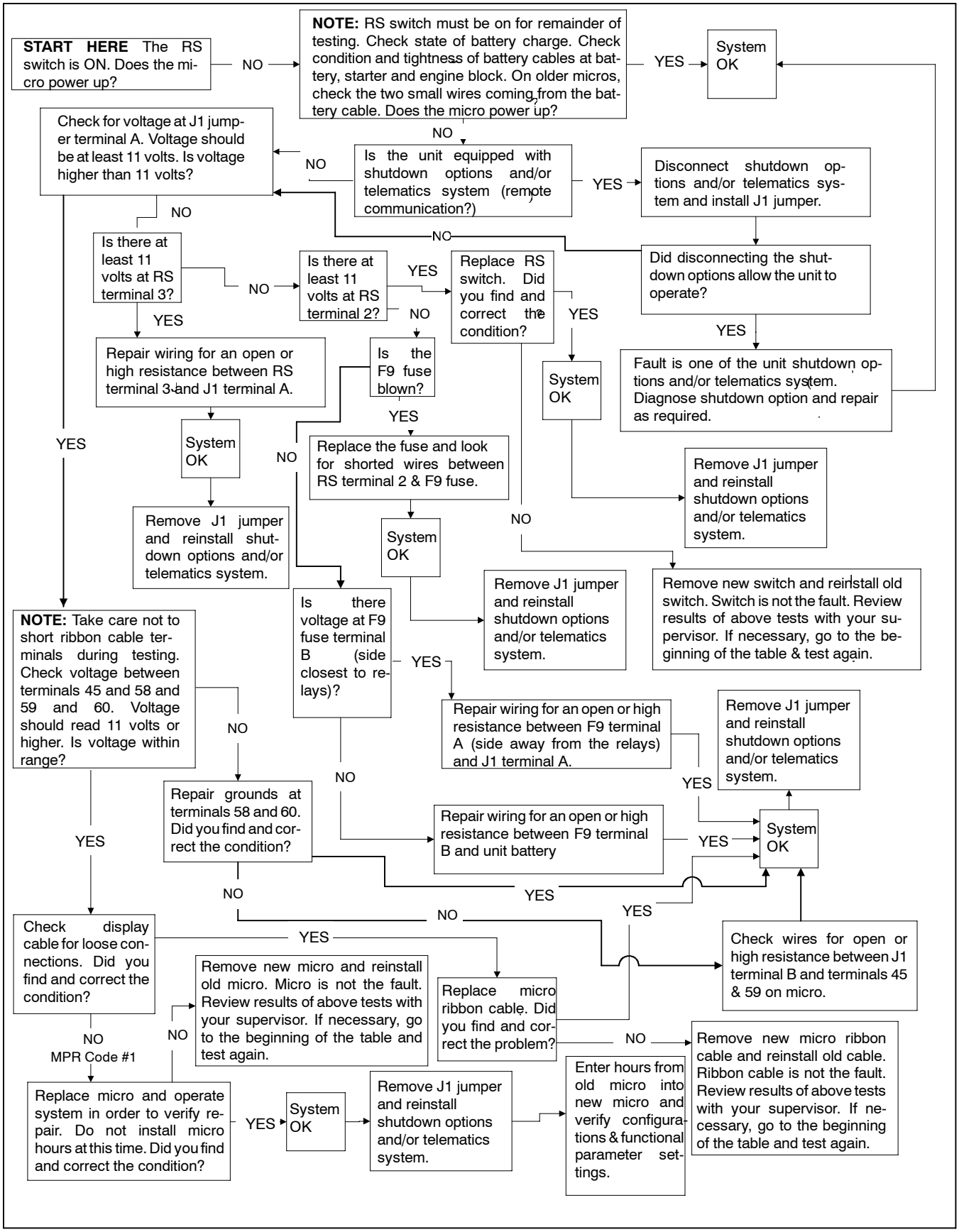

START HERE The RS switch is ON. Does the micro power up?
NO
NOTE: RS switch must be on for remainder of testing. Check state of battery charge. Check condition and tightness of battery cables at battery, starter and engine block. On older micros, check the two small wires coming from the battery cable. Does the micro power up?
YES
System OK
NO
Check for voltage at J1 jumper terminal A. Voltage should be at least 11 volts. Is voltage higher than 11 volts?
NO
Is the unit equipped with shutdown options and/or telematics system (remote communication?)
YES
Disconnect shutdown options and/or telematics system and install J1 jumper.
NO
Did disconnecting the shutdown options allow the unit to operate?
YES
Fault is one of the unit shutdown options and/or telematics system. Diagnose shutdown option and repair as required.
Is there at least 11 volts at RS terminal 3?
NO
Is there at least 11 volts at RS terminal 2?
YES
Replace RS switch. Did you find and correct the condition?
YES
System OK
NO
Remove J1 jumper and reinstall shutdown options and/or telematics system.
YES
Repair wiring for an open or high resistance between RS terminal 3 and J1 terminal A.
Is the F9 fuse blown?
YES
Replace the fuse and look for shorted wires between RS terminal 2 & F9 fuse.
System OK
Remove J1 jumper and reinstall shutdown options and/or telematics system.
NO
Remove new switch and reinstall old switch. Switch is not the fault. Review results of above tests with your supervisor. If necessary, go to the beginning of the table & test again.
YES
System OK
NO
Remove J1 jumper and reinstall shutdown options and/or telematics system.
NOTE: Take care not to short ribbon cable terminals during testing. Check voltage between terminals 45 and 58 and 59 and 60. Voltage should read 11 volts or higher. Is voltage within range?
Is there voltage at F9 fuse terminal B (side closest to relays)?
YES
Repair wiring for an open or high resistance between F9 terminal A (side away from the relays) and J1 terminal A.
Remove J1 jumper and reinstall shutdown options and/or telematics system.
YES
NO
Repair grounds at terminals 58 and 60. Did you find and correct the condition?
NO
Repair wiring for an open or high resistance between F9 terminal B and unit battery
YES
System OK
YES
NO
YES
NO
YES
Check display cable for loose connections. Did you find and correct the condition?
YES
Remove new micro and reinstall old micro. Micro is not the fault. Review results of above tests with your supervisor. If necessary, go to the beginning of the table and test again.
Replace micro ribbon cable. Did you find and correct the problem?
NO
Remove new micro ribbon cable and reinstall old cable. Ribbon cable is not the fault. Review results of above tests with your supervisor. If necessary, go to the beginning of the table and test again.
Check wires for open or high resistance between J1 terminal B and terminals 45 & 59 on micro.
NO
MPR Code #1
NO
Replace micro and operate system in order to verify repair. Do not install micro hours at this time. Did you find and correct the condition?
YES
System OK
Remove J1 jumper and reinstall shutdown options and/or telematics system.
Enter hours from old micro into new micro and verify configurations & functional parameter settings.

Figure 5-5. Micro Diagnostic Tree - Cond. 1 - RS Switch On - Micro does not power up

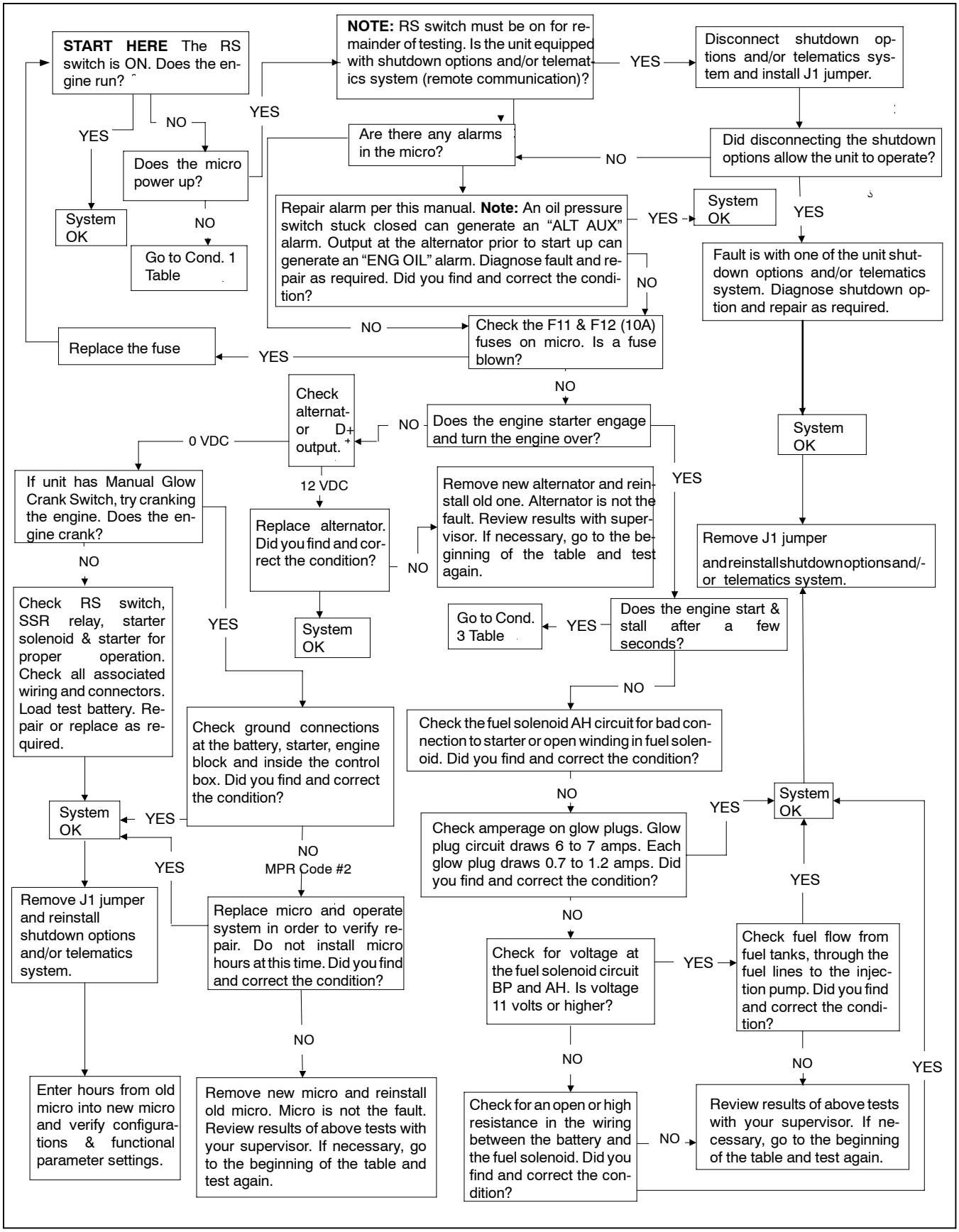

START HERE The RS switch is ON. Does the engine run?
YES
NO
Does the micro power up?
YES
NO
System OK
Go to Cond. 1 Table
NOTE: RS switch must be on for remainder of testing. Is the unit equipped with shutdown options and/or telematics system (remote communication)?
YES
Disconnect shutdown options and/or telematics system and install J1 jumper.
Are there any alarms in the micro?
NO
Did disconnecting the shutdown options allow the unit to operate?
YES
Repair alarm per this manual. Note: An oil pressure switch stuck closed can generate an "ALT AUX" alarm. Output at the alternator prior to start up can generate an "ENG OIL" alarm. Diagnose fault and repair as required. Did you find and correct the condition?
YES
System OK
NO
Fault is with one of the unit shutdown options and/or telematics system. Diagnose shutdown option and repair as required.
NO
Check the F11 & F12 (10A) fuses on micro. Is a fuse blown?
YES
Replace the fuse
NO
Check alternator D+ output.
0 VDC
12 VDC
NO
Does the engine starter engage and turn the engine over?
YES
System OK
If unit has Manual Glow Crank Switch, try cranking the engine. Does the engine crank?
NO
Replace alternator. Did you find and correct the condition?
NO
Remove new alternator and reinstall old one. Alternator is not the fault. Review results with supervisor. If necessary, go to the beginning of the table and test again.
Remove J1 jumper and reinstall shutdown options and/or telematics system.
Check RS switch, SSR relay, starter solenoid & starter for proper operation. Check all associated wiring and connectors. Load test battery. Repair or replace as required.
YES
System OK
Go to Cond. 3 Table
YES
Does the engine start & stall after a few seconds?
NO
Check ground connections at the battery, starter, engine block and inside the control box. Did you find and correct the condition?
Check the fuel solenoid AH circuit for bad connection to starter or open winding in fuel solenoid. Did you find and correct the condition?
NO
System OK
YES
Check amperage on glow plugs. Glow plug circuit draws 6 to 7 amps. Each glow plug draws 0.7 to 1.2 amps. Did you find and correct the condition?
YES
System OK
YES
NO
MPR Code #2
Remove J1 jumper and reinstall shutdown options and/or telematics system.
Replace micro and operate system in order to verify repair. Do not install micro hours at this time. Did you find and correct the condition?
NO
Check for voltage at the fuel solenoid circuit BP and AH. Is voltage 11 volts or higher?
YES
Check fuel flow from fuel tanks, through the fuel lines to the injection pump. Did you find and correct the condition?
NO
NO
YES
Enter hours from old micro into new micro and verify configurations & functional parameter settings.
Remove new micro and reinstall old micro. Micro is not the fault. Review results of above tests with your supervisor. If necessary, go to the beginning of the table and test again.
Check for an open or high resistance in the wiring between the battery and the fuel solenoid. Did you find and correct the condition?
NO
Review results of above tests with your supervisor. If necessary, go to the beginning of the table and test again.

Figure 5-6. Micro Diagnostic Tree - Cond. 2 (Models with Speed Control Solenoid) - RS Switch On - Engine does not operate

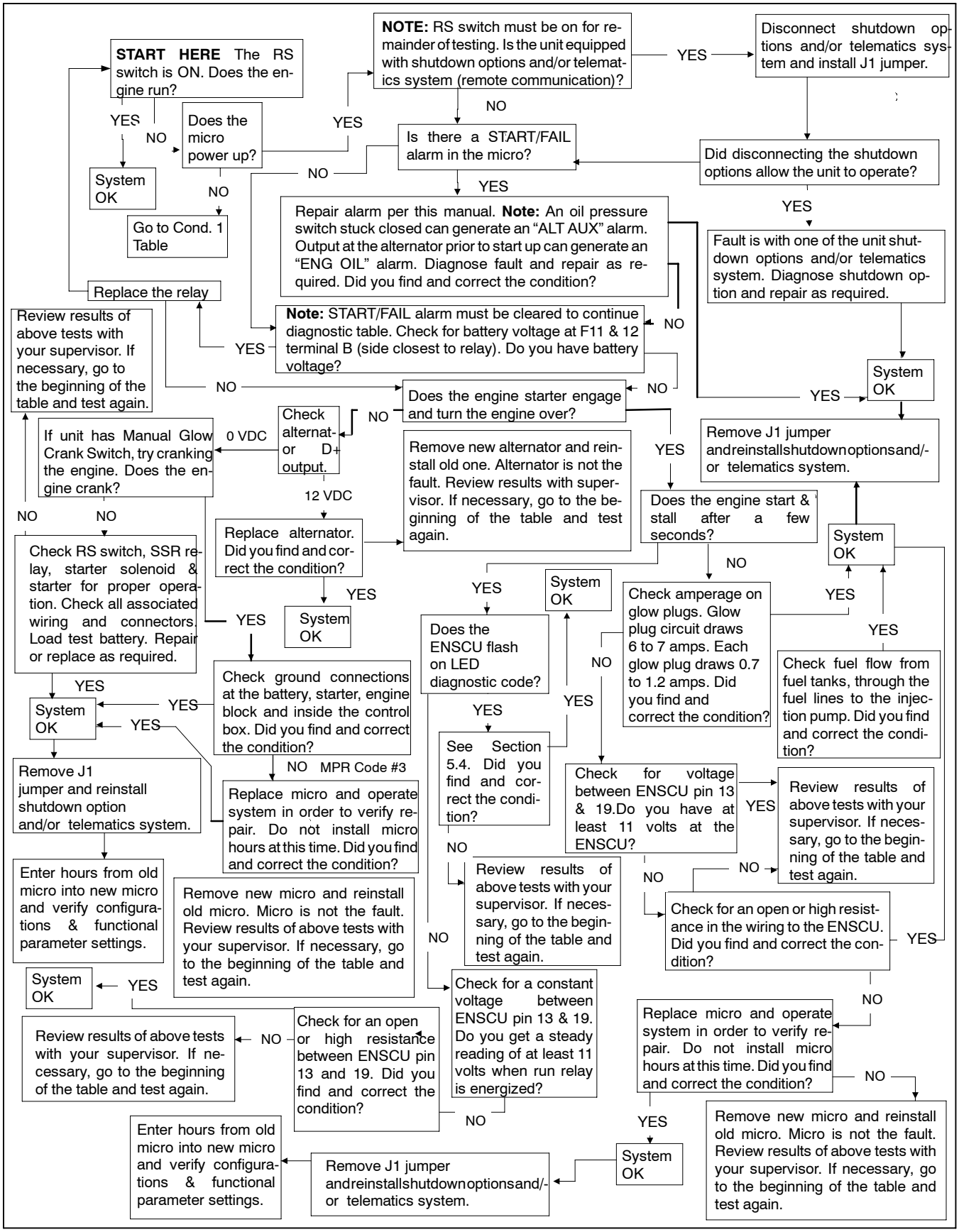

START HERE The RS switch is ON. Does the engine run?
YES
NO
System OK
Does the micro power up?
NO
Go to Cond. 1 Table
Replace the relay
Review results of above tests with your supervisor. If necessary, go to the beginning of the table and test again.
NOTE: RS switch must be on for remainder of testing. Is the unit equipped with shutdown options and/or telematics system (remote communication)?
YES
Disconnect shutdown options and/or telematics system and install J1 jumper.
NO
YES
Is there a START/FAIL alarm in the micro?
NO
Did disconnecting the shutdown options allow the unit to operate?
YES
Repair alarm per this manual. Note: An oil pressure switch stuck closed can generate an "ALT AUX" alarm. Output at the alternator prior to start up can generate an "ENG OIL" alarm. Diagnose fault and repair as required. Did you find and correct the condition?
Fault is with one of the unit shutdown options and/or telematics system. Diagnose shutdown option and repair as required.
Note: START/FAIL alarm must be cleared to continue diagnostic table. Check for battery voltage at F11 & 12 terminal B (side closest to relay). Do you have battery voltage?
YES
NO
NO
YES
System OK
Does the engine starter engage and turn the engine over?
NO
YES
Remove J1 jumper and reinstall shutdown options and/or telematics system.
If unit has Manual Glow Crank Switch, try cranking the engine. Does the engine crank?
0 VDC
Check alternator D+ output.
12 VDC
Remove new alternator and reinstall old one. Alternator is not the fault. Review results with supervisor. If necessary, go to the beginning of the table and test again.
Does the engine start & stall after a few seconds?
NO
YES
NO
NO
Check RS switch, SSR relay, starter solenoid & starter for proper operation. Check all associated wiring and connectors. Load test battery. Repair or replace as required.
Replace alternator. Did you find and correct the condition?
YES
System OK
YES
YES
System OK
Does the ENSCU flash on LED diagnostic code?
YES
NO
Check amperage on glow plugs. Glow plug circuit draws 6 to 7 amps. Each glow plug draws 0.7 to 1.2 amps. Did you find and correct the condition?
YES
YES
Check fuel flow from fuel tanks, through the fuel lines to the injection pump. Did you find and correct the condition?
YES
System OK
YES
YES
Check ground connections at the battery, starter, engine block and inside the control box. Did you find and correct the condition?
NO
MPR Code #3
Replace micro and operate system in order to verify repair. Do not install micro hours at this time. Did you find and correct the condition?
YES
See Section 5.4. Did you find and correct the condition?
NO
Review results of above tests with your supervisor. If necessary, go to the beginning of the table and test again.
Check for voltage between ENSCU pin 13 & 19.Do you have at least 11 volts at the ENSCU?
YES
NO
Review results of above tests with your supervisor. If necessary, go to the beginning of the table and test again.
NO
Check for an open or high resistance in the wiring to the ENSCU. Did you find and correct the condition?
YES
Remove J1 jumper and reinstall shutdown option and/or telematics system.
Enter hours from old micro into new micro and verify configurations & functional parameter settings.
Remove new micro and reinstall old micro. Micro is not the fault. Review results of above tests with your supervisor. If necessary, go to the beginning of the table and test again.
NO
Check for a constant voltage between ENSCU pin 13 & 19. Do you get a steady reading of at least 11 volts when run relay is energized?
NO
Replace micro and operate system in order to verify repair. Do not install micro hours at this time. Did you find and correct the condition?
NO
YES
System OK
YES
Review results of above tests with your supervisor. If necessary, go to the beginning of the table and test again.
NO
Check for an open or high resistance between ENSCU pin 13 and 19. Did you find and correct the condition?
NO
Enter hours from old micro into new micro and verify configurations & functional parameter settings.
Remove J1 jumper and reinstall shutdown options and/or telematics system.
YES
System OK
Remove new micro and reinstall old micro. Micro is not the fault. Review results of above tests with your supervisor. If necessary, go to the beginning of the table and test again.

Figure 5-7. Micro Diagnostic Tree - Cond. 2 (ESC) - RS Switch On - Engine does not operate

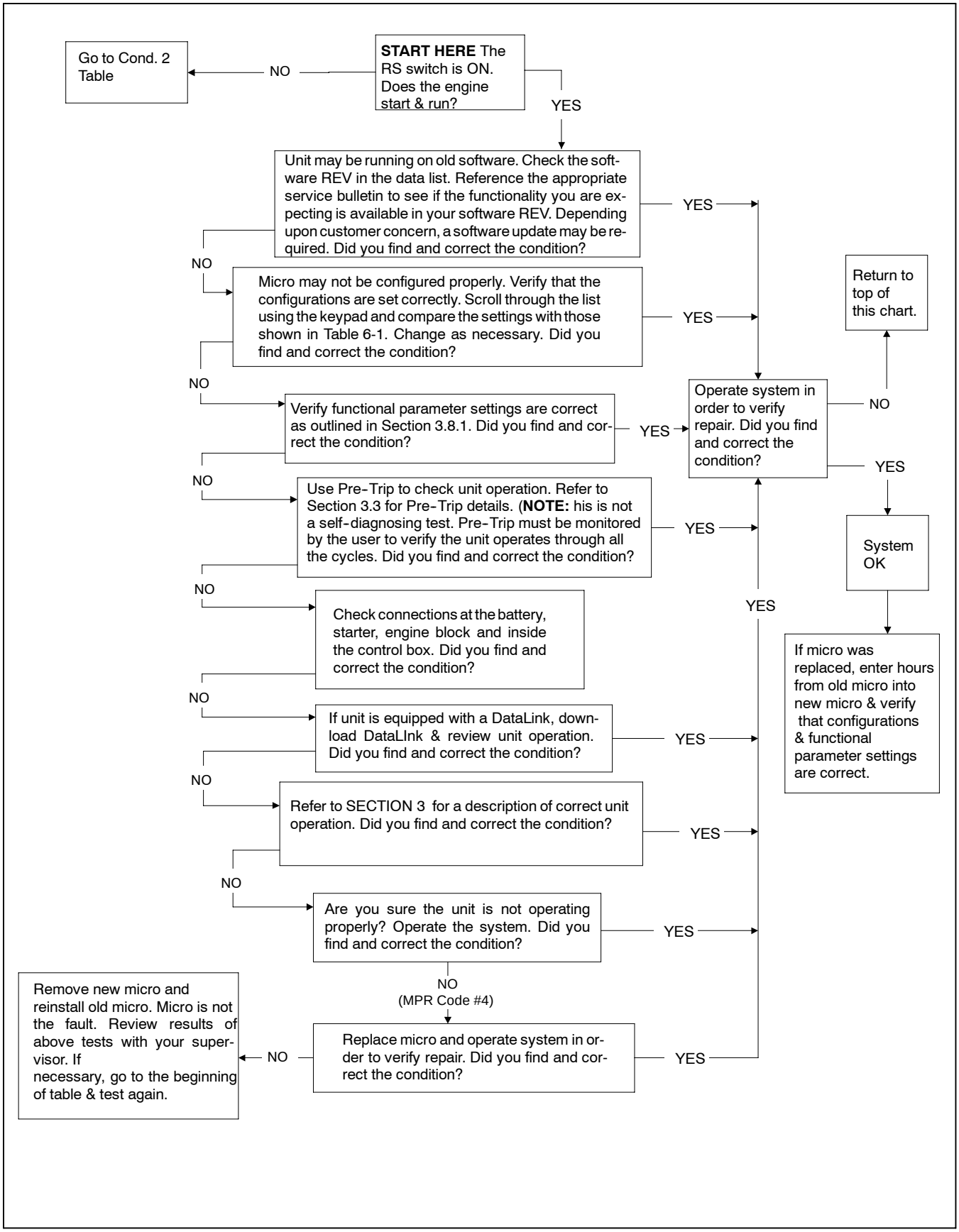

Go to Cond. 2 Table
NO
START HERE The RS switch is ON. Does the engine start & run?
YES
Unit may be running on old software. Check the software REV in the data list. Reference the appropriate service bulletin to see if the functionality you are expecting is available in your software REV. Depending upon customer concern, a software update may be required. Did you find and correct the condition?
YES
NO
Micro may not be configured properly. Verify that the configurations are set correctly. Scroll through the list using the keypad and compare the settings with those shown in Table 6-1. Change as necessary. Did you find and correct the condition?
YES
NO
Verify functional parameter settings are correct as outlined in Section 3.8.1. Did you find and correct the condition?
YES
NO
Use Pre-Trip to check unit operation. Refer to Section 3.3 for Pre-Trip details. (NOTE: his is not a self-diagnosing test. Pre-Trip must be monitored by the user to verify the unit operates through all the cycles. Did you find and correct the condition?
YES
NO
Check connections at the battery, starter, engine block and inside the control box. Did you find and correct the condition?
YES
NO
If unit is equipped with a DataLink, download DataLInk & review unit operation. Did you find and correct the condition?
YES
NO
Refer to SECTION 3 for a description of correct unit operation. Did you find and correct the condition?
YES
NO
Are you sure the unit is not operating properly? Operate the system. Did you find and correct the condition?
YES
NO
(MPR Code #4)
Replace micro and operate system in order to verify repair. Did you find and correct the condition?
YES
NO
Remove new micro and reinstall old micro. Micro is not the fault. Review results of above tests with your supervisor. If necessary, go to the beginning of table & test again.
Operate system in order to verify repair. Did you find and correct the condition?
NO
Return to top of this chart.
YES
System OK
If micro was replaced, enter hours from old micro into new micro & verify that configurations & functional parameter settings are correct.

Figure 5-8. Micro Diagnostic Tree - Cond. 3 - RS Switch On - Engine Operates But Not Properly

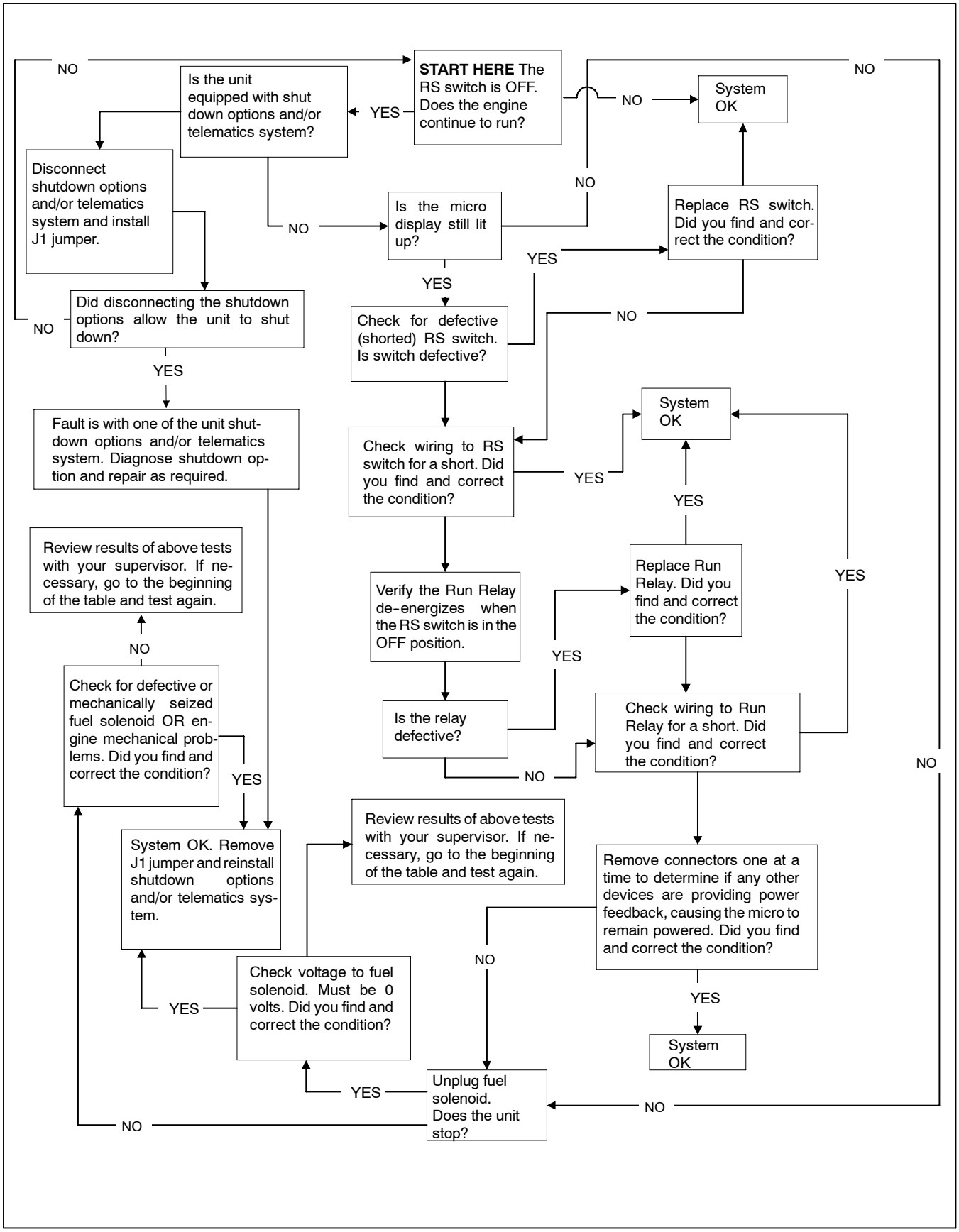

START HERE The RS switch is OFF. Does the engine continue to run?
YES
NO
System OK
Is the unit equipped with shut down options and/or telematics system?
NO
Disconnect shutdown options and/or telematics system and install J1 jumper.
Is the micro display still lit up?
NO
YES
Replace RS switch. Did you find and correct the condition?
YES
NO
Did disconnecting the shutdown options allow the unit to shut down?
NO
YES
Check for defective (shorted) RS switch. Is switch defective?
NO
YES
Fault is with one of the unit shutdown options and/or telematics system. Diagnose shutdown option and repair as required.
Check wiring to RS switch for a short. Did you find and correct the condition?
YES
System OK
YES
Review results of above tests with your supervisor. If necessary, go to the beginning of the table and test again.
Verify the Run Relay de-energizes when the RS switch is in the OFF position.
Replace Run Relay. Did you find and correct the condition?
YES
NO
Check for defective or mechanically seized fuel solenoid OR engine mechanical problems. Did you find and correct the condition?
Is the relay defective?
YES
NO
Check wiring to Run Relay for a short. Did you find and correct the condition?
YES
NO
System OK. Remove J1 jumper and reinstall shutdown options and/or telematics system.
Review results of above tests with your supervisor. If necessary, go to the beginning of the table and test again.
Remove connectors one at a time to determine if any other devices are providing power feedback, causing the micro to remain powered. Did you find and correct the condition?
NO
YES
Check voltage to fuel solenoid. Must be 0 volts. Did you find and correct the condition?
YES
System OK
YES
Unplug fuel solenoid. Does the unit stop?
NO
NO

Figure 5-9. Micro Diagnostic Tree - Cond. 4 (Models with Speed Control Solenoid) - RS Switch Off - Engine fails to stop

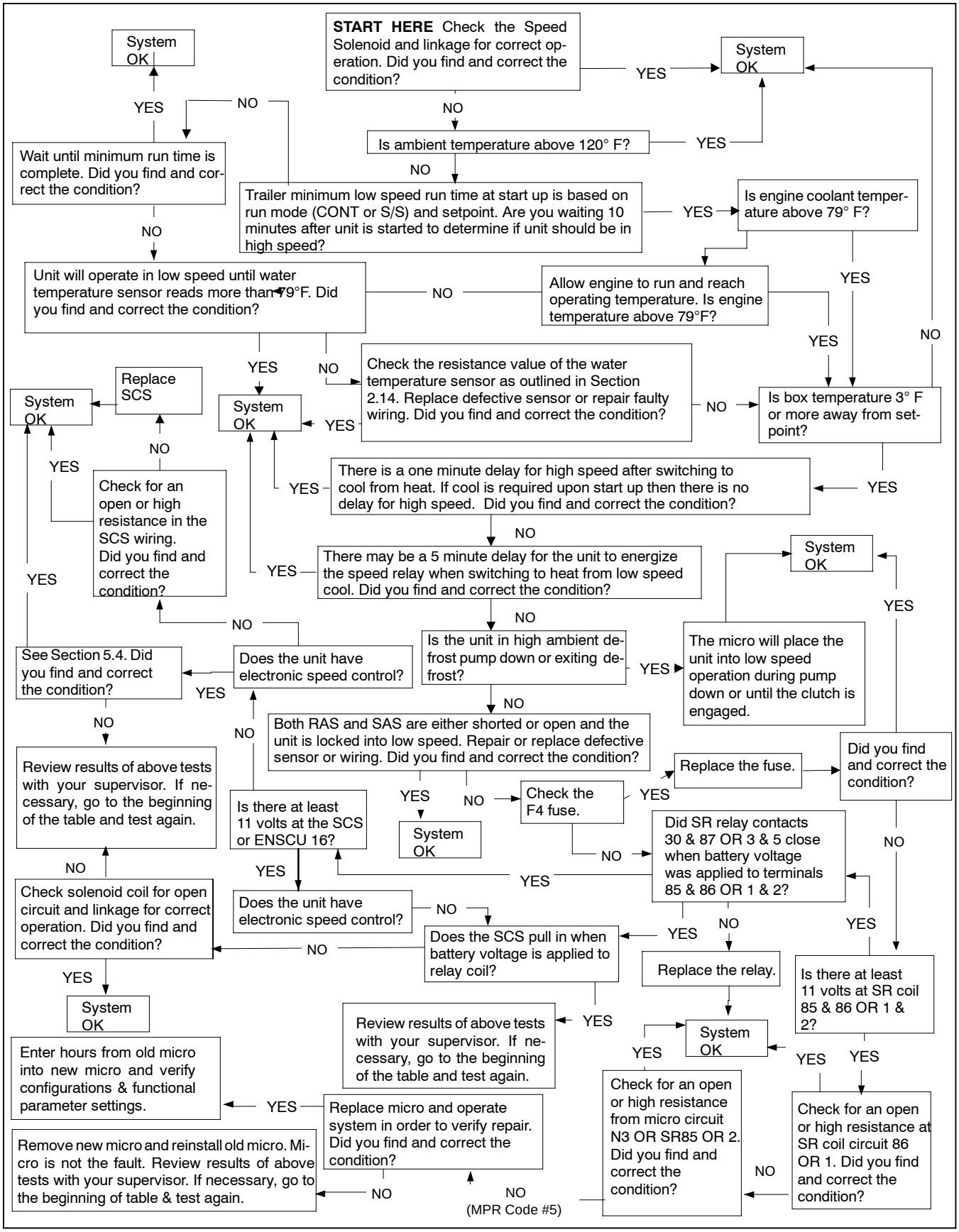

START HERE Check the Speed Solenoid and linkage for correct operation. Did you find and correct the condition?
YES
System OK
NO
Is ambient temperature above 120° F?
YES
NO
Trailer minimum low speed run time at start up is based on run mode (CONT or S/S) and setpoint. Are you waiting 10 minutes after unit is started to determine if unit should be in high speed?
YES
Is engine coolant temperature above 79° F?
NO
Wait until minimum run time is complete. Did you find and correct the condition?
YES
NO
Unit will operate in low speed until water temperature sensor reads more than 79°F. Did you find and correct the condition?
NO
Allow engine to run and reach operating temperature. Is engine temperature above 79°F?
YES
NO
Check the resistance value of the water temperature sensor as outlined in Section 2.14. Replace defective sensor or repair faulty wiring. Did you find and correct the condition?
YES
NO
Replace SCS
System OK
Is box temperature 3° F or more away from setpoint?
YES
NO
Check for an open or high resistance in the SCS wiring. Did you find and correct the condition?
There is a one minute delay for high speed after switching to cool from heat. If cool is required upon start up then there is no delay for high speed. Did you find and correct the condition?
There may be a 5 minute delay for the unit to energize the speed relay when switching to heat from low speed cool. Did you find and correct the condition?
Is the unit in high ambient defrost pump down or exiting defrost?
The micro will place the unit into low speed operation during pump down or until the clutch is engaged.
See Section 5.4. Did you find and correct the condition?
Does the unit have electronic speed control?
Both RAS and SAS are either shorted or open and the unit is locked into low speed. Repair or replace defective sensor or wiring. Did you find and correct the condition?
Replace the fuse.
Did you find and correct the condition?
Review results of above tests with your supervisor. If necessary, go to the beginning of the table and test again.
Is there at least 11 volts at the SCS or ENSCU 16?
Check the F4 fuse.
Did SR relay contacts 30 & 87 OR 3 & 5 close when battery voltage was applied to terminals 85 & 86 OR 1 & 2?
Check solenoid coil for open circuit and linkage for correct operation. Did you find and correct the condition?
Does the unit have electronic speed control?
Does the SCS pull in when battery voltage is applied to relay coil?
Replace the relay.
Is there at least 11 volts at SR coil 85 & 86 OR 1 & 2?
Review results of above tests with your supervisor. If necessary, go to the beginning of the table and test again.
Enter hours from old micro into new micro and verify configurations & functional parameter settings.
Replace micro and operate system in order to verify repair. Did you find and correct the condition?
Remove new micro and reinstall old micro. Micro is not the fault. Review results of above tests with your supervisor. If necessary, go to the beginning of table & test again.
Check for an open or high resistance from micro circuit N3 OR SR85 OR 2. Did you find and correct the condition?
Check for an open or high resistance at SR coil circuit 86 OR 1. Did you find and correct the condition?
(MPR Code #5)

Figure 5-10. Micro Diagnostic Tree - Cond. 5 (Models with Speed Control Solenoid) - Unit will not run in high speed

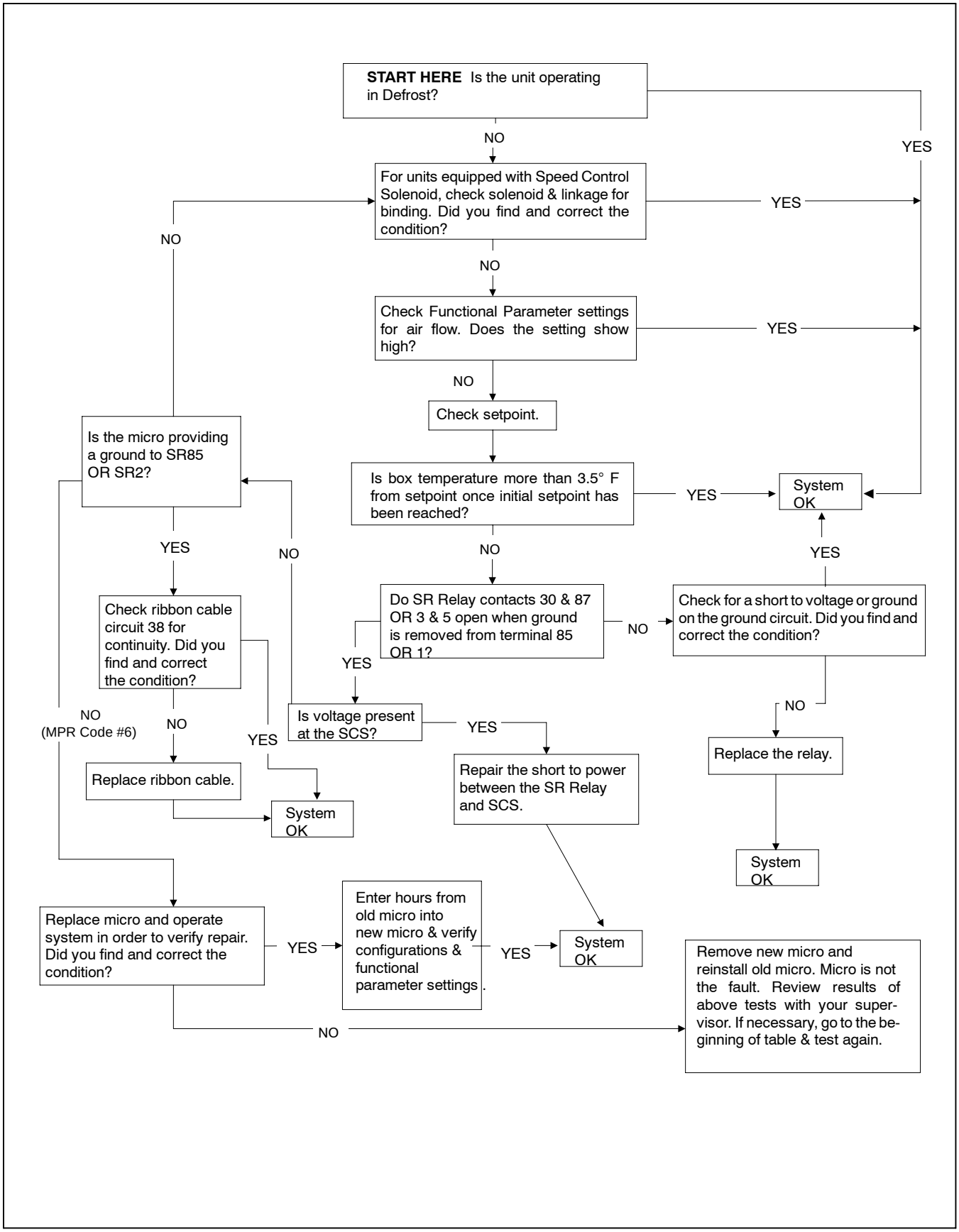

START HERE Is the unit operating in Defrost?
YES
NO
For units equipped with Speed Control Solenoid, check solenoid & linkage for binding. Did you find and correct the condition?
YES
NO
Check Functional Parameter settings for air flow. Does the setting show high?
YES
NO
Check setpoint.
Is box temperature more than 3.5° F from setpoint once initial setpoint has been reached?
YES
System OK
NO
Do SR Relay contacts 30 & 87 OR 3 & 5 open when ground is removed from terminal 85 OR 1?
NO
Check for a short to voltage or ground on the ground circuit. Did you find and correct the condition?
YES
NO
Replace the relay.
System OK
YES
Is voltage present at the SCS?
YES
Repair the short to power between the SR Relay and SCS.
NO
Is the micro providing a ground to SR85 OR SR2?
YES
NO
Check ribbon cable circuit 38 for continuity. Did you find and correct the condition?
NO
YES
Replace ribbon cable.
System OK
NO (MPR Code #6)
Replace micro and operate system in order to verify repair. Did you find and correct the condition?
YES
Enter hours from old micro into new micro & verify configurations & functional parameter settings.
YES
System OK
NO
Remove new micro and reinstall old micro. Micro is not the fault. Review results of above tests with your supervisor. If necessary, go to the beginning of table & test again.

Figure 5-11. Micro Diagnostic Tree - Cond. 6 - Unit will not run in low speed

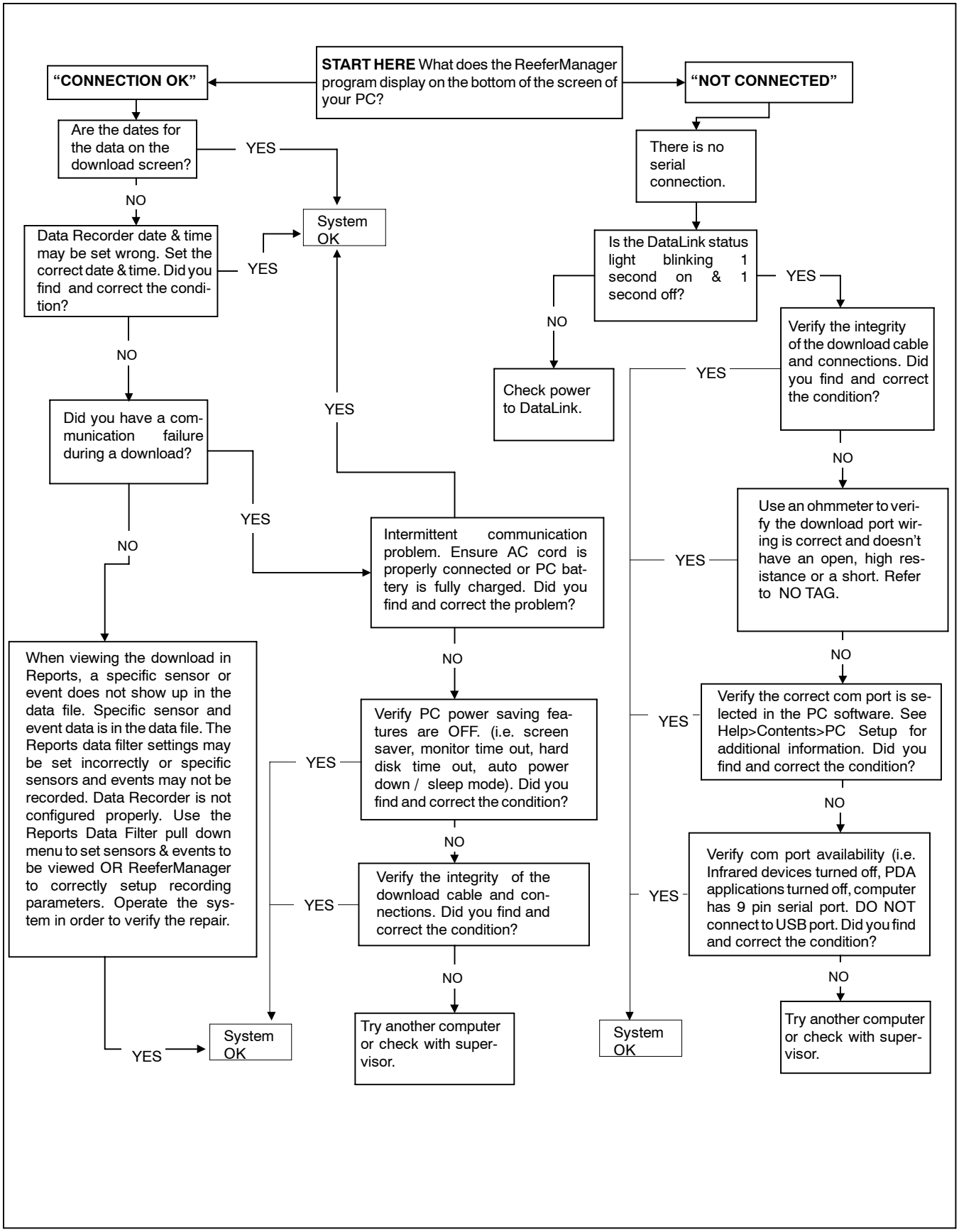

START HERE What does the ReeferManager program display on the bottom of the screen of your PC?
"CONNECTION OK"
"NOT CONNECTED"
Are the dates for the data on the download screen?
YES
NO
System OK
Data Recorder date & time may be set wrong. Set the correct date & time. Did you find and correct the condition?
YES
NO
Did you have a communication failure during a download?
YES
NO
When viewing the download in Reports, a specific sensor or event does not show up in the data file. Specific sensor and event data is in the data file. The Reports data filter settings may be set incorrectly or specific sensors and events may not be recorded. Data Recorder is not configured properly. Use the Reports Data Filter pull down menu to set sensors & events to be viewed OR ReeferManager to correctly setup recording parameters. Operate the system in order to verify the repair.
YES
System OK
Intermittent communication problem. Ensure AC cord is properly connected or PC battery is fully charged. Did you find and correct the problem?
NO
Verify PC power saving features are OFF. (i.e. screen saver, monitor time out, hard disk time out, auto power down / sleep mode). Did you find and correct the condition?
YES
NO
Verify the integrity of the download cable and connections. Did you find and correct the condition?
YES
NO
Try another computer or check with supervisor.
There is no serial connection.
Is the DataLink status light blinking 1 second on & 1 second off?
YES
NO
Check power to DataLink.
Verify the integrity of the download cable and connections. Did you find and correct the condition?
YES
NO
Use an ohmmeter to verify the download port wiring is correct and doesn't have an open, high resistance or a short. Refer to NO TAG.
YES
NO
Verify the correct com port is selected in the PC software. See Help>Contents>PC Setup for additional information. Did you find and correct the condition?
YES
NO
Verify com port availability (i.e. Infrared devices turned off, PDA applications turned off, computer has 9 pin serial port. DO NOT connect to USB port. Did you find and correct the condition?
YES
NO
Try another computer or check with supervisor.
System OK

Figure 5-12. Micro Diagnostic Tree - Cond. 7 - Data Recorder Data Download Problems when using ReeferManager and a download cable.

SECTION 6 – SERVICE

WARNING

⚠ WARNING

Beware of V-belts and belt driven components as the unit may start automatically. Before servicing unit, make sure the Run/Stop switch is in the STOP position. Also disconnect the negative battery cable.

CAUTION

⚠ CAUTION

For units with R404A and POE oil, the use of inert gas brazing procedures is mandatory; otherwise compressor failure will occur. For more information see Technical Procedure 98-50553-00 Inert Gas Brazing

NOTE

To avoid damage to the earth's ozone layer, use a refrigerant recovery system whenever removing refrigerant. When working with refrigerants you must comply with all local government environmental laws.

6.1 MAINTENANCE SCHEDULE

SYSTEM	OPERATION	ACTION/- REFERENCE SECTION
a. Daily Maintenance		
	Pre-Trip Inspection - before starting	6.2
	Check Engine Hours	Check
	Check Engine Oil Level	Check
b. Every Service Interval or Annually		
Unit	1. Check unit mounting bolts	Check
	2. Check engine and compressor mount bolts	Check
	3. Check door latches & hinges	Check
	4. Check gauges, switches and electrical connections	Check
	5. Check all belt tensions	6.11
	6. Check control box	Check
	7. Check gearbox and fan shaft for oil leaks	Check
	8. Check fan shaft, idler and gearbox bearings	Check
	9. Check clutch air gap and adjust as required	Check
Engine	1. Check oil/filter change interval[1] (refer to section **f.** of this table)	6.10.2
	2. Check for oil leaks	Check
	3. Check low oil pressure safety	2.13
	4. Clean crankcase breather	6.10.6
	5. Check engine speeds for units without electronic speed control	Table 2-1
Fuel System	1. Clean fuel pump strainer	6.8
	2. Change fuel filter(s) (refer to section **f.** of this table)	6.8
	3. Check fuel heater (optional)	---
Cooling System	1. Clean radiator/condenser fin surface	6.10.1 and 6.30
	2. Check antifreeze concentration	6.10.1
	3. Check water pump	Check
	4. Check water temperature sensor functions	2.8
Exhaust System	1. Check mounting hardware	Check
	2. Check muffler and exhaust pipes	Check
Air Intake System	1. Change air cleaner element	Check
	2. Check and replace air filter indicator if needed	6.10.5
Starting System	1. Check battery condition	Check/Replace
	2. Clean battery connections and cable ends	Check/Replace
	3. Check battery hold down clamps	Check
	4. Check starter operation	Check
Charging System	1. Check alternator brushes and replace if necessary	Check
	2. Check alternator output	2.14

SYSTEM	OPERATION	ACTION/- REFERENCE SECTION
b. Every Service Interval[1] or Annually (Continued)		
Refrigera- tion System	1. Check air switch & calibrate 2. Check & clean evaporator coil and defrost drain hoses 3. Check operating refrigerant pressure 4. Check all sensor calibrations 5. Check manual defrost operation 6. Check Compressor drive coupling 7. Perform Pre-Trip inspection	4.15 6.29 Check Check Check Check 6.2
c. Every 6000 Hour Maintenance (Normal Operating Conditions) with conventional coolant		
Cooling System	1. Drain and flush cooling system **(12,000 hours with Extended Life Coolant)**	Section 6.10.1
d. Every 10,000 Hour Maintenance		
Perform complete 2000 and 3000 hour Preventive Maintenance and the following:		
Fuel System	1. Clean and adjust injector nozzles.	Engine Service Guide
e. Every 12,000 Hour Maintenance with extended life coolant		
Cooling System	1. Drain and flush cooling system **(6,000 hours with Conventional Coolant)**	Section 6.10.1

f. Oil And Filter Change Intervals		
	Oil & Filter Change Interval using API Class CG engine oil	**Oil & Filter Change Interval using Mobil Delvac engine oil***
Standard Oil Filter	2000 hrs/1yr	4000 hrs/1yr
ESI Oil Filter	3000 hrs/2 yrs	4000 hrs/2 yrs

* Mobil Delvac is the only approved synthetic oil. Maximum oil drain interval is two (2) years.

These maintenance schedules are based on the use of approved oils and regular pretrip inspections of the unit. Failure to follow the recommended maintenance schedule may affect the life and reliability of the refrigeration unit.

6.2 PRETRIP INSPECTION

⚠ WARNING

Inspect battery cables for signs of wear, abrasion or damage at every Pre-Trip inspection and replace if necessary. Also check battery cable routing to ensure that clamps are secure and that cables are not pinched or chafing against any components.

The following pretrip inspection should be performed before every trip and at regular maintenance intervals.

BEFORE STARTING ENGINE
Drain water from bottom of fuel tank
Drain water from water separator on fuel filter (if applicable)
Check radiator coolant level
Check condenser coil for cleanliness
Check radiator coil for cleanliness
Check air filter and hoses
Check engine oil level
Check condition and tension of belts
Check all fan and idler bearings
Check door latches and hinges
Check condition of condenser fan blades
Check battery fluid level (if applicable)
Check battery cables and terminals
Check evaporator coil for cleanliness
Check air chute (if applicable)
Check bulkhead and return air screen (If applicable)
Check all defrost water drains
Place in Continuous Run, and start unit.
IMMEDIATELY AFTER STARTING ENGINE
Check starter for proper engagement
Check fuel lines and filters for leaks
Check oil lines and filters for leaks
Check coolant hoses for leaks
Check exhaust system for leaks
Check condenser fan for proper airflow.
Check evaporator fan for proper airflow.
Ensure clutch engages properly – no slip or unusual noises
Check for unusual noises – alternator, fan shaft, water pump, idler and gearbox, bearings, etc.

PRETRIP
Initiate Pretrip
List any Pretrip Alarms
AFTER OPERATING UNIT FOR 15 MINUTES OR MORE
Check refrigerant level
Check compressor oil level (Refer to Section 6.19)
Check for proper temperature control
Check auto-start/stop operation
Initiate Pretrip
OPERATE IN HIGH SPEED COOL AND RECORD (From Microprocessor Unit Data List)
SUCTION PRESSURE . . . . .
ENGINE COOLANT TEMP . . . . .
RETURN AIR TEMP . . . . .
SUPPLY AIR TEMP . . . . .
AMBIENT AIR TEMP . . . . .
COMP DISCH TEMP . . . . .
BATTERY VOLTAGE . . . . .
SOFTWARE REVISION . . . . .
SERIAL NUMBER UPPER . . . . .
SERIAL NUMBER LOWER . . . . .
FINAL
Review Functional Parameters
Download recorder data (if equipped with DataLink)

6.3 DOOR LATCH MAINTENANCE

Door latch mechanisms require periodic lubrication. Use of spray white lithium grease is recommended for the latch assembly and the latch pins that are mounted on the unit's frame (See Figure 6-1).

6.4 GRILLE INSERT REMOVAL (See Figure 6-1)

Removal of insert will ease in condenser coil cleaning. (Refer to Section 6.30).

a. Remove the 3 bolts on each side of the grille insert.

b. Remove the 2 bolts on top of the grille insert.

c. Swing insert down and lift out of locating holes.

d. Reverse above steps to install new grille insert.

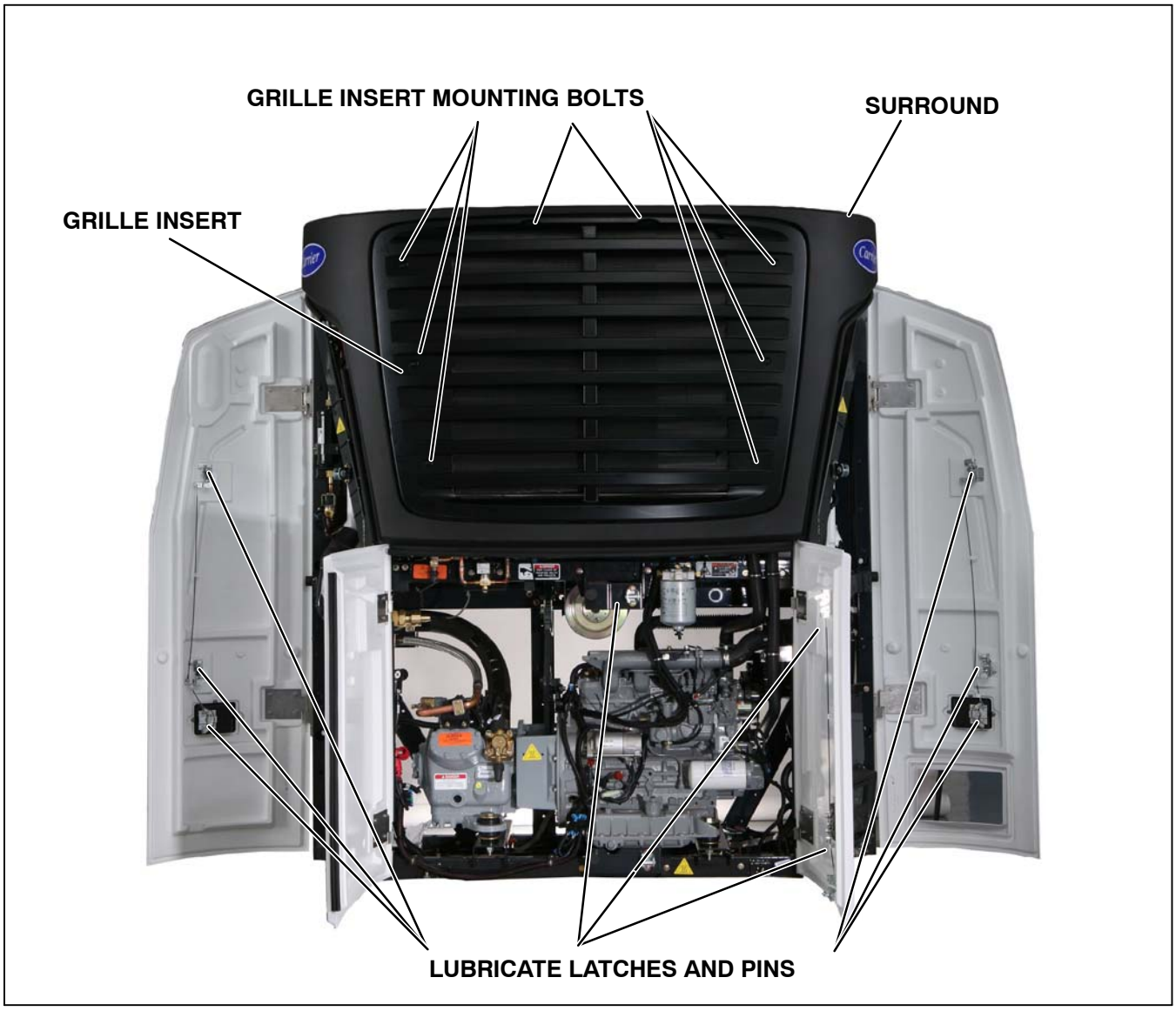


Figure 6-1. Door Latch Maintenance And Grille Insert Removal

6.5 SURROUND REMOVAL

a. Turn the SROS to the “OFF” position and disconnect the starter.

b. Open both side and front doors.

c. Remove the bolts that secure the surround to the unit.

d. Reverse above steps to install new surround.

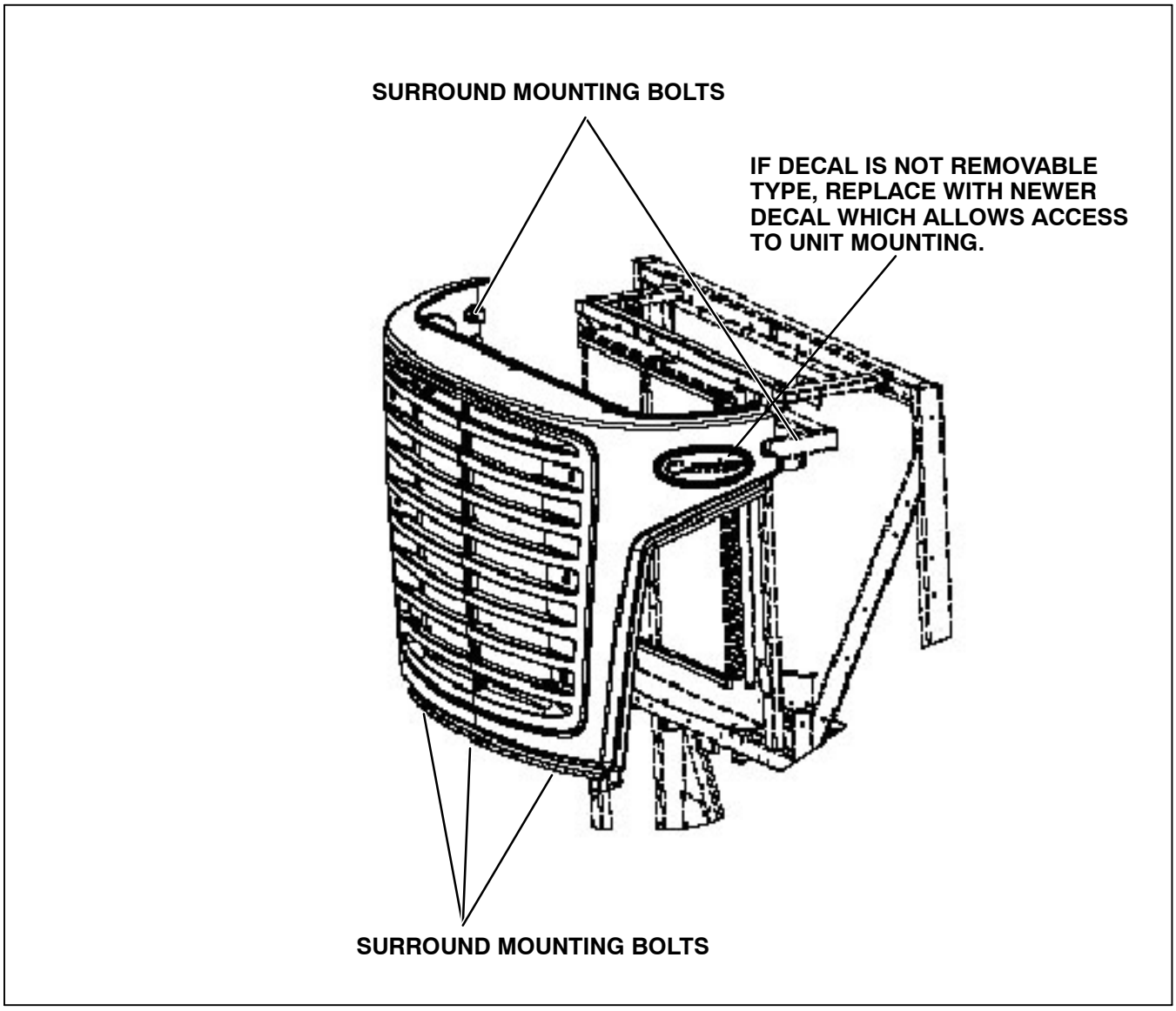

SURROUND MOUNTING BOLTS
IF DECAL IS NOT REMOVABLE TYPE, REPLACE WITH NEWER DECAL WHICH ALLOWS ACCESS TO UNIT MOUNTING.
SURROUND MOUNTING BOLTS

Figure 6-2. Surround Removal

6.6 DOOR LATCH CABLE REPLACEMENT

6.6.1 Front Door Latch Cable Replacement

a. Remove circular clip that secures the cable to the paddle assembly.

b. Slide cable from paddle and rotate other end out of latch assembly.

c. Reverse above steps to install new cable.

6.6.2 Side Door Latch Cable Replacement

a. Remove circular clip that secures the cable to the paddle assembly.

b. Remove the lower cable from the paddle assembly and the lower latch.

NOTE

The lower cable is threaded through the upper cable eyelet and the lower latch assembly. (See Figure 6-3)

c. Remove the upper cable from the upper latch.

d. Reverse above steps to install new cable.

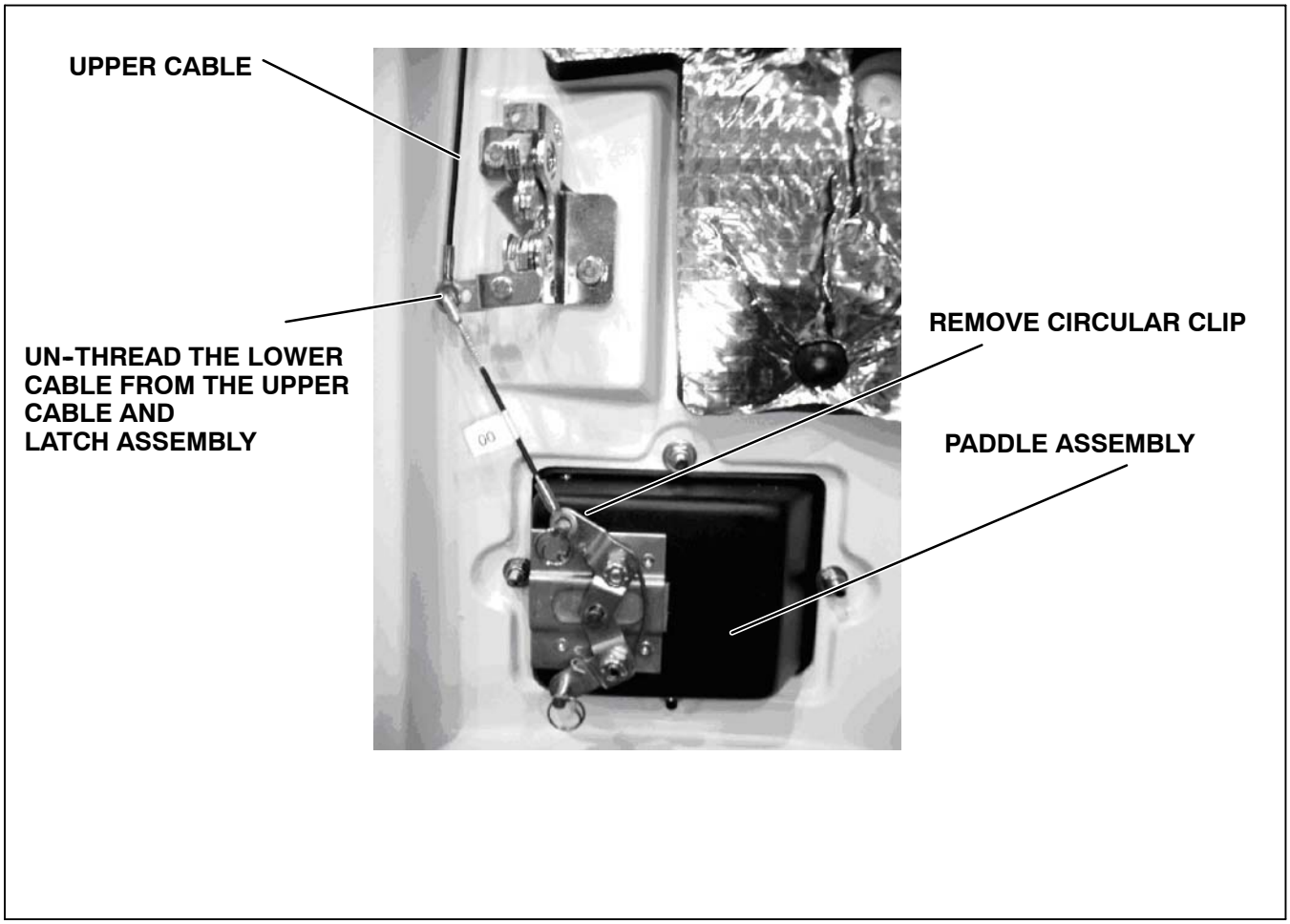


Figure 6-3. Side Door Latch Lower Cable Removal

6.7 PRIMING FUEL SYSTEM

6.7.1 Mechanical Fuel Pump

The mechanical fuel lift pump is mounted on the engine next to the injection pump. This pump has a manual plunger for priming the fuel system when the fuel tank has been run dry. (See Figure 6-4).

To prime the fuel system, use the following steps:

a. Turn the bleed valve (Red) counter-clockwise until fully opened.

b. Turn the top of the manual fuel pump plunger counter--clockwise to unlock it. **S-L-O-W-L-Y** (up/down once per second) pump the manual plunger until positive pressure (resistance) is felt. This may take up to 200 strokes. This will indicate fuel flow.

c. Continue to pump **S-L-O-W-L-Y** (up/down once per second) approximately 100 more strokes to fill the filter and bleed the air out of the lines.

d. Start engine. It may be necessary to continue to pump until the engine starts.

e. Depress and turn the top of the manual plunger clockwise to **lock in place.**

f. When engine is running smoothly, turn bleed valve clockwise until fully closed.

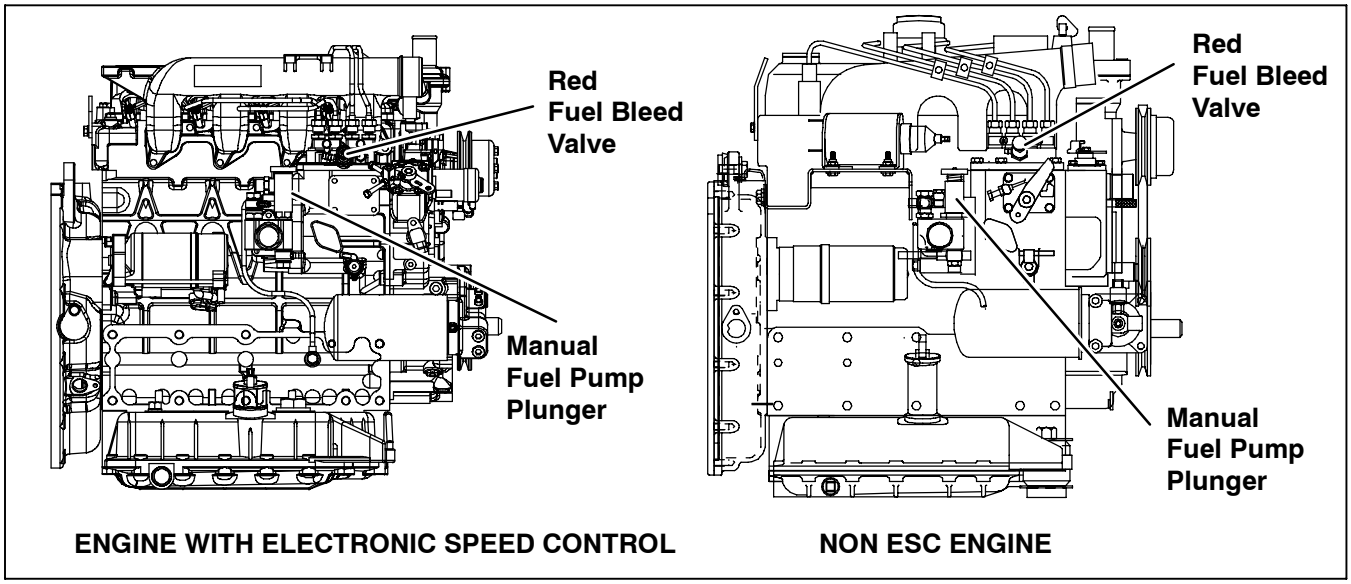


Figure 6-4. Priming Fuel Pump

6.7.2 Electrical Fuel Pump

If the unit is equipped with an optional electrical fuel pump, it will be mounted on the fuel tank mounting bracket. Use the following steps to bleed out the fuel system:

a. Turn the bleed valve (Red) counter-clockwise until fully opened. (See Figure 6-4)

b. Place unit in Manual Start Mode. (ManOp). (See Section 3.2.) Once the Run Relay energizes the fuel pump will start.

c. Allow the electric pump to operate for 2–3 minutes.

d. Place controller in Auto Op to start engine.

e. When engine is running properly, turn bleed valve clockwise until fully closed.

6.8 Servicing Fuel Pump

The fuel filter may become plugged or restricted with foreign particles or wax as a result of using the wrong grade of fuel or untreated fuel in cold weather. This will cause the engine to lose capacity. The filter must be cleaned on a regular schedule such as unit pre-trip or when the oil and fuel filters are changed (Refer to Section 6.1).

a. Turn bolt counter-clockwise to loosen and remove (item 1, Figure 6-5).

NOTE

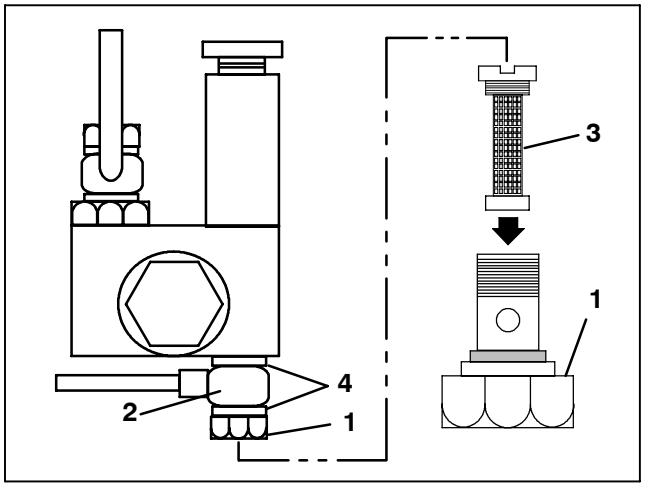
Once bolt is removed fuel may drain from the fuel line. Care should be taken to avoid spillage.

b. Remove banjo fitting (item 2) and let it hang loose, making sure to keep copper rings (item 4) for replacement.

c. Turn filter (item 3) counter-clockwise and remove. Check and clean.

d. Replace copper rings (item 4) with new rings.

e. To install reverse steps 1 through 3.



1. Bolt
2. Banjo
3. Filter
4. Copper Rings

Figure 6-5. Mechanical Fuel Pump

6.9 ALTERNATOR / REGULATOR

With the unit OFF and the alternator not rotating, the D+ circuit should be 0 VDC. If voltage is present when the unit is OFF, the regulator has failed and needs to be replaced. (See 2.3.2.b. for information on proper voltage of D+ circuit.)

6.10 ENGINE SERVICE & COMPONENTS

6.10.1 Cooling System

Air flows through the condenser/radiator.

The radiator, externally and internally, must be clean for adequate cooling. The upper drive V-belt must be adjusted periodically to provide maximum air flow. (Refer to Section 6.11.3)

⚠ CAUTION

Use only ethylene glycol anti-freeze (with inhibitors) in system as glycol by itself will damage the cooling system.
Always add pre-mixed 50/50 anti-freeze and water to radiator/engine. Never exceed more than a 60% concentration of anti--freeze. Use a low silicate anti-freeze meeting GM specifications GM 6038M or equal.

Do the following to service the cooling system:

a. Remove all foreign material from the radiator coil by reversing the normal air flow if possible. (Air is pulled in through the front and discharges out the top of the unit.) Compressed air or water may be used as a cleaning agent. It may be necessary to use warm water mixed with any good commercial dishwasher detergent. Rinse coil with fresh water if a detergent is used.

NOTE

Draining the coolant from the engine petcock will leave approximately 1 quart (.9 liters) of coolant in the block. To completely drain the coolant, the lower radiator hose must be removed.

b. Drain coolant.

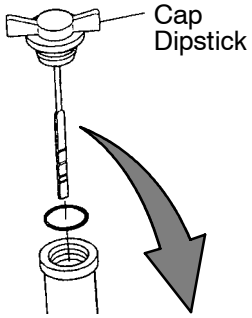
c. Install hose and fill system with clean, untreated water to which 3 - 5% of an alkaline based radiator cleaner is added – 6 oz (151 grams) to 1 gallon (3.78 liters) of water. OR

d. Close drain cock and fill system with clean, untreated water to which three to five percent of an alkaline based radiator cleaner should be added [six dry ounces (151 grams) to one gallon (3.78 liters) of water].

e. Run engine 6 to 12 hours and drain system while warm. Rinse system three times after it has cooled down. Refill system with water.

f. Run engine to operating temperature. Drain system again and fill with 50/50 water/anti-freeze mixture. (see Caution Note and Refer to Section 2.8) NEVER POUR COLD WATER INTO A HOT ENGINE, however hot water can always be added to a cold engine.

6.10.2 Lube Oil Filters



To check the engine oil level: Run the unit to bring the engine up to operating temperature, shut the unit off, and unscrew the cap/dipstick. Wipe the dipstick clean and insert the cap into the oil fill tube without threading it into the oil fill tube. Remove the dipstick again and check oil level. DO NOT add oil if the level is in the "safe" range. If needed, add oil as indicated by markings on dipstick until level is in the "safe" range.

QTS	2	1	SAFE	

To Change Engine Oil and Filters:

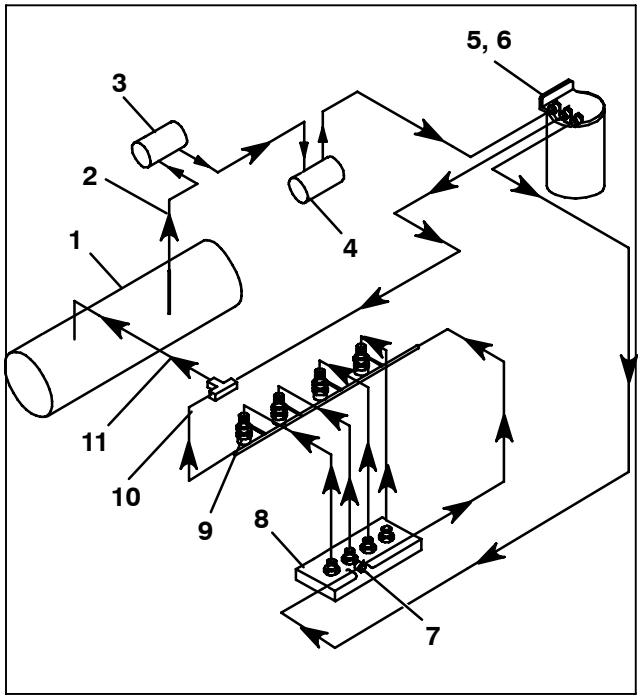
After warming up the engine, stop engine, remove drain plug from oil reservoir and drain engine lube oil. Lightly oil gasket on filter before installing. Tighten per the filter manufacturer's directions.

⚠ CAUTION

When changing oil filters, the new filters should be primed with clean oil. If the filters are not primed, the engine may operate for a period with no oil supplied to the bearings.

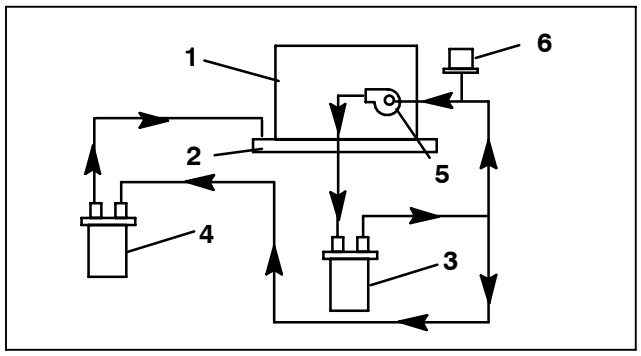
Replace filter(s) and add lube oil. (Refer to Section 2.8) Warm up engine and check for leaks.

a. LUBE OIL & FUEL FLOW DIAGRAMS



1. Fuel Tank
2. Fuel Supply Line
3. Electric Fuel Pump (Optional)
4. Mechanical Lift Pump
5. Fuel Filter
6. Fuel Warmer (Optional)
7. Fuel Bleed Valve
8. Injection Pump
9. Injector Nozzles
10. Fuel Leak-off Line
11. Fuel Return Line

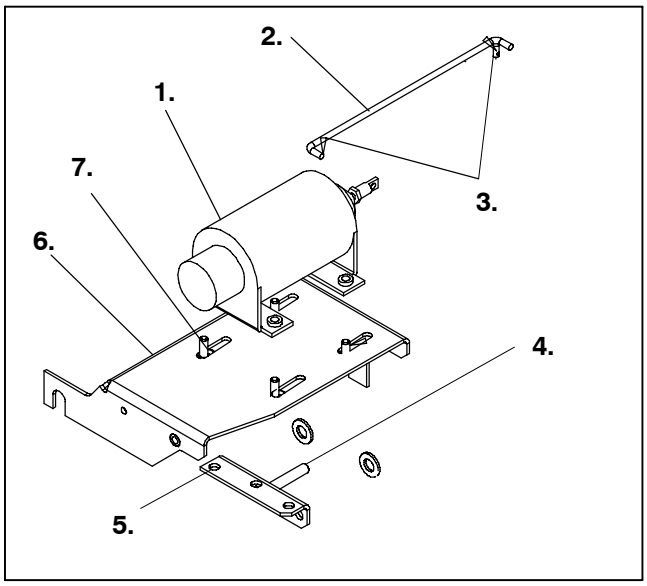
Figure 6-6. Fuel System Diagram



1. Engine Block
2. Oil Pan
3. Full Flow Oil Filter
4. Bypass Oil Filter (Optional)
5. Engine Oil Connection
6. Oil Pressure Switch

Figure 6-7. Lube Oil Flow Diagram

6.10.3 Servicing the Speed Control Solenoid and Linkage – Non ESC engines only (Refer to Section 6.10.4 for information on units with Electronic Speed Control).



1. Solenoid
2. Linkage (Speed)
3. Clip
4. Adjustment Nut
5. Adjustment Bracket
6. Solenoid Bracket
7. Bolt

Figure 6-8. Speed Control Solenoid

a. Solenoid Removal/Replacement

1. Disconnect wiring to solenoid. Disconnect linkage arm (item 2., Figure 6-8) from solenoid. Remove mounting hardware from solenoid and then remove solenoid.

2. Install replacement solenoid (Item 1.) and mounting hardware. Do not tighten at this time.

3. Attach linkage to solenoid and install the clip (Item 3.) to the linkage rod.

b. Low Speed Adjustment

1. Hold the speed lever against the low speed stop and check the RPM (Refer to Table 1-1). Adjust the low speed stop screw if necessary.

2. Check engine speed. With the engine stopped, place a mark on the crankshaft sheave (white paint for example). Speed may be verified by a Strobette model 964 (strobe-tachometer) Carrier Transicold P/N 07-00206.

c. High Speed Adjustment

Energize the speed solenoid. Adjust the adjustment nut (Item 4.) until the correct RPMs are obtained then tighten the solenoid mounting bolts (Item 7.)

NOTE

LE (Low Emission) DI engines are delivered with a tamper resistant high-speed adjustment screw on the engine. High-speed adjustments are made using the slotted holes in the solenoid mounting bracket and the speed solenoid adjusting bracket with solenoid adjusting bolt and lockout (on the bracket).

6.10.4 Electronic Speed Control (ESC) (Units beginning with below serial numbers and ALL X2 units)

- Extra – KAV90912317
- Ultra – KAV90910499

Refer to Section 7 for schematic wiring diagram. Refer to Section 5.4 for ESC diagnostic alarms and diagnostic trees.

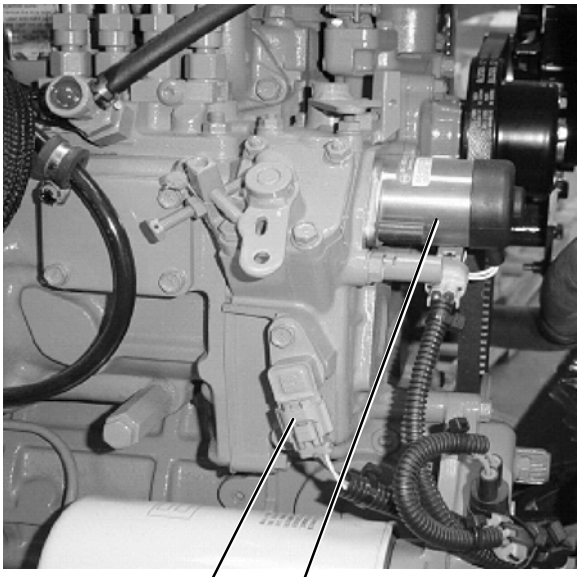


Figure 6-9. Electronic Speed Control Components

Engines with electronic speed control have no speed or fuel solenoids. Engine speed is controlled by way of three components: the engine speed control unit (ENSCU), the fuel and speed actuator (FSA) and the engine speed sensor (ENSSN). The FSA performs the same function as the solenoids. The ENSSN performs the same function as the RPM sensor.

The ENSCU is mounted on the roadside frame behind the upper door. It provides the RPM signal to the microprocessor. The unit has an alarm LED incorporated within it, which is used to diagnose failures within the ESC system.

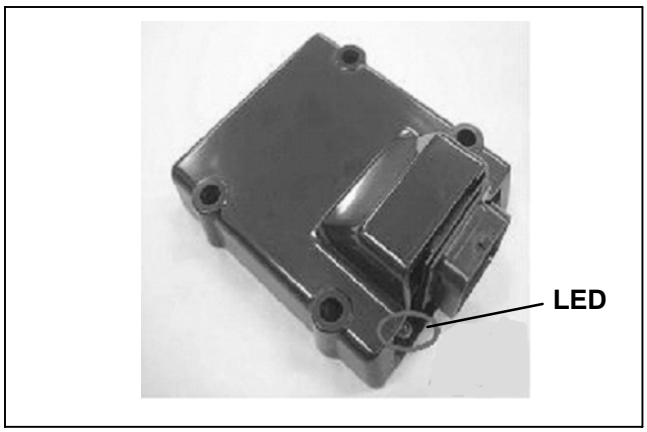


Figure 6-10. Frame Mounted Engine Speed Control Unit (ENSCU)

The FSA combines the fuel shutoff solenoid and speed control solenoid into one component. Engine speed is controlled by varying rod position.

The ENSSN provides the RPM signal to the ENSCU for speed control.

6.10.5 Engine Air Cleaner

a. Inspection

The air cleaner should be inspected regularly for leaks. A damaged air cleaner or hose can seriously affect the performance and life of the engine. The air cleaner is designed to effectively remove contaminants from the air stream entering the engine. An excessive accumulation of these contaminants in the air cleaner will impair its operation, therefore, a service schedule must be set up and followed. The air cleaner filter element requires replacement when dirty.

b. Air Cleaner Service Indicator (Optional)

An optional air cleaner indicator can be connected to the engine air intake manifold and its function is to indicate when the air cleaner requires replacing. In operation: When a plugged air cleaner decreases intake manifold pressure to 20" (500 mm) WG, the indicator moves to the red line. The air cleaner should be replaced and the indicator reset by pressing the reset button.

c. Service Procedure

1. Stop the engine, and open roadside door.
2. Release 2 clips on air cleaner housing and remove bottom cover.
3. Remove filter element, wipe clean inside of air cleaner housing and install new filter element.
4. Wipe clean inside of bottom cover and re-install.
5. Re-secure 2 clips on air cleaner housing and close roadside door.

6.10.6 Engine Crankcase Breather

The engine uses a closed type breather with the breather line attached to the cylinder head cover. (See Figure 6-11 or Figure 6-12)

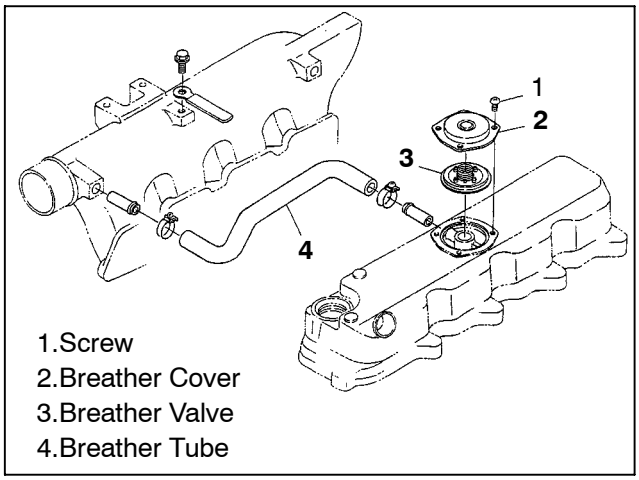
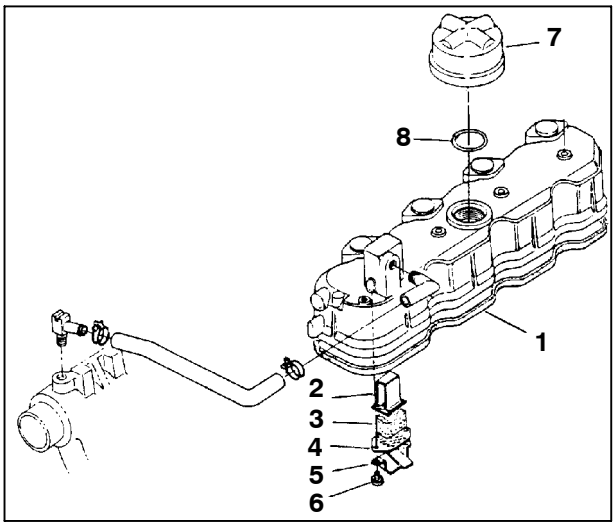


Figure 6-11. DI- Engine Crankcase Breather



1. Cylinder Head Cover
2. Breather Cover
3. Breather Element
4. Plate
5. Breather Oil Shield
6. Bolt
7. Breather Assembly
8. O-Ring

Figure 6-12. TV -Engine Crankcase Breather

6.10.7 Servicing Glow Plugs

The glow plugs, when energized, draw a nominal 6 to 9 amps at 12 VDC. When servicing, the glow plug is to be fitted carefully into the cylinder head to prevent damage to glow plug. Torque value for the glow plug is 14 to 18 ft--lb (19 to 24 Nm).

Checking for a Defective Glow Plug

a. To test individual glow plugs, disconnect all glow plugs from each other, and place an ammeter (or clip--on ammeter) in series with each glow plug and energize the plugs. Each plug (if good) should show 6 to 9 amps draw (at 12 VDC).

b. A second method is to disconnect the wire connection to the plug and test the resistance from the plug to a ground on the engine block. The reading should be 0.7 to 1.2 ohms if the plug is good.

6.11 SERVICING & ADJUSTING V-BELTS

⚠ WARNING

Beware of V-belts and belt driven components as the unit may start automatically. Before servicing unit, make sure the Run/Stop switch is in the STOP position. Also disconnect the negative battery cable.

6.11.1 Belt Tension Gauge

Use a belt tension gauge (tester) P/N 07-00253, shown in Figure 6-13 whenever V-belts are adjusted or replaced.

A belt tension gauge provides an accurate and easy method of adjusting belts to their proper tension. Properly adjusted belts give long lasting and efficient service. Too much tension SHORTENS belt and bearing life, and too little tension causes slippage and excessive belt wear. It is also important to keep belts and sheaves free of any foreign material which may cause the belts to slip.

The belt tension gauge can be used to adjust all belts. The readings which we specify for Carrier Transicold units are applicable only for our belts and application, as the tension is dependent on the size of the belt and distance between sheaves. When using this gauge, it should be placed as close as possible to the midpoint between two sheaves.

The V-belts must be kept in good condition with the proper tension to provide adequate air movement across the coils.

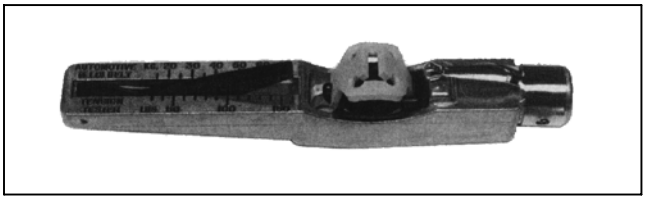


Figure 6-13. DI– Belt Tension Gauge (Part No. 07-00253)

6.11.2.Water Pump/Alternator V-Belt

The water pump V-belt is driven by a sheave on the engine crankshaft. Frayed, cracked or worn belts must be replaced. Adjustment is achieved by altering the position of the alternator.

When replacing a V-belt, avoid excessive force when applying tension to the V-belt to prevent damage to the water pump bearings. (Refer to Table 6-1.)

a. Make sure negative battery terminal is disconnected and remove old belt.

b. Place V-belt on alternator sheave and then install alternator with two bolts loosely in position.

c. Check the center alignment of the engine drive, alternator and water pump sheaves to ensure proper alignment. Pulley misalignment will create excess belt wear and shorten alternator bearing life. The center line of all three sheaves must be in line.

d. Pivot alternator to place tension on belt using hand force only. *Do not use pry bar or excessive force as it may cause bearing failure.* For correct belt tension see Table 6-1. Tighten pivot and adjustment bolts.

e. Reinstall negative battery cable.

Table 6-1. Belt Tension (See Figure 6-14)

BELTS	Replacement Belt Initial Tension		Replacement Belt Tension After 15 Minutes of Running Time	
	Lbs	Mkg	Lbs	Mkg
Water Pump/Alternator/Crankshaft	45 to 55	6.2 to 7.6	45 to 55	6.2 to 7.6
Gearbox to Fan shaft	140	19.4	70 to 80	9.7 to 11.1
Engine to Gearbox	140	19.4	70 to 80	9.7 to 11.1

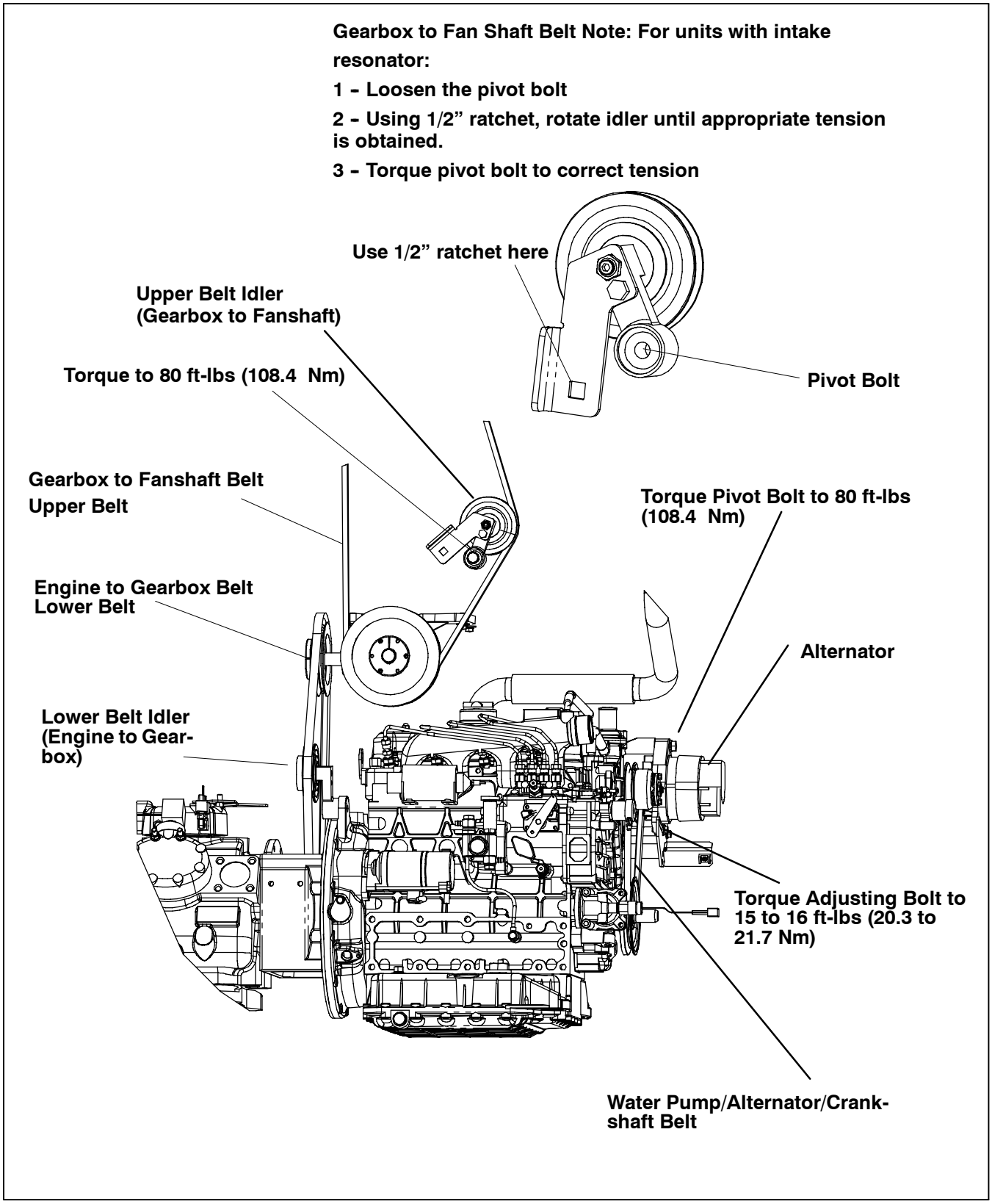

Gearbox to Fan Shaft Belt Note: For units with intake resonator:
1 – Loosen the pivot bolt
2 – Using 1/2” ratchet, rotate idler until appropriate tension is obtained.
3 – Torque pivot bolt to correct tension
Use 1/2” ratchet here
Upper Belt Idler (Gearbox to Fanshaft)
Torque to 80 ft-lbs (108.4 Nm)
Pivot Bolt
Gearbox to Fanshaft Belt Upper Belt
Torque Pivot Bolt to 80 ft-lbs (108.4 Nm)
Engine to Gearbox Belt Lower Belt
Alternator
Lower Belt Idler (Engine to Gear-box)
Torque Adjusting Bolt to 15 to 16 ft-lbs (20.3 to 21.7 Nm)
Water Pump/Alternator/Crank-shaft Belt

Figure 6-14. V-Belt Arrangement

6.11.3 Gearbox To Fanshaft And Engine To Gearbox V-Belts

a. Gearbox to Fanshaft V-Belt (Upper Belt)

⚠ WARNING

Keep hands and arms away from unit when operating without belt guard in place. Never release a unit for service without the belt guard securely tightened in place.

1. Disconnect negative battery cable and remove V-belt guard.
2. DO NOT START UNIT UNTIL V-BELT GUARD IS INSTALLED.
3. Loosen idler pulley.
4. Remove old belt and replace with new belt.

NOTE

Belt tension should be measured at the center of the belt.

5. Using a belt tension gauge (Figure 6-13) on the belt, rotate idler pulley so that the gauge reads the correct tension (Refer to Table 6-1).
6. Torque idler retaining bolt. (See Figure 6-14).

NOTE

Both belts must be checked and re-tensioned after a brief run-in period. (See step 7.)

7. Reconnect negative battery cable, and install belt guard and operate unit in high speed for 15 minutes. Remove guard and disconnect battery. Repeat steps 5. and 6.
8. Replace belt guard.
9. Reconnect battery cable.

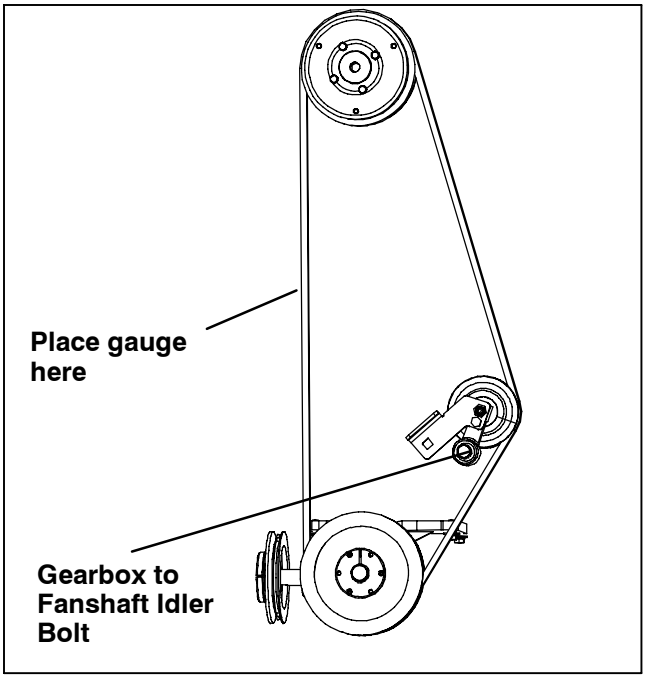


Figure 6-15. Gauge Placement

b. Engine To Gearbox V-Belt (Lower Belt)

1. Disconnect negative battery cable and remove V-belt guard and then loosen idler bolt.
2. Match mark adapter to engine flywheel (See Figure 6-16A) for ease of assembly.
3. Remove six bolts (M8 x 1.25 x 20mm lg) securing adapter drive sheave to engine flywheel, Figure 6-16A.
4. Insert 2 of the six bolts (M8 x 1.25 x 20mm lg) into the threaded holes (jacking holes) provided on engine adapter. Jack adapter from engine flywheel. Remove the 2 screws from adapter. Insert a pry bar between engine flywheel and adapter, Figure 6-16A and slide the adapter-sheave toward the compressor enough to change the V-belt as shown in Figure 6-16B. Replace V-belt.
5. Pry the adapter back toward the engine flywheel until the bolts will start in the engine flywheel. Apply thread sealer (Loctite #262) to the bolts used to secure adapter to flywheel. Tighten all bolts evenly and then torque to a value of 28 ft-lb (38 Nm).
6. Place V-belt on the Gearbox sheave and adjust belt tension as indicated in Table 6-1. Install V-belt guard. DO NOT START UNIT UNTIL V-BELT GUARD IS INSTALLED.
7. Reconnect negative battery cable. Start unit and run for 15 minutes to allow for belt stretch.
8. Turn off unit and then disconnect battery cable. Remove belt guard and belt and recheck belt tension. Install belt guard.

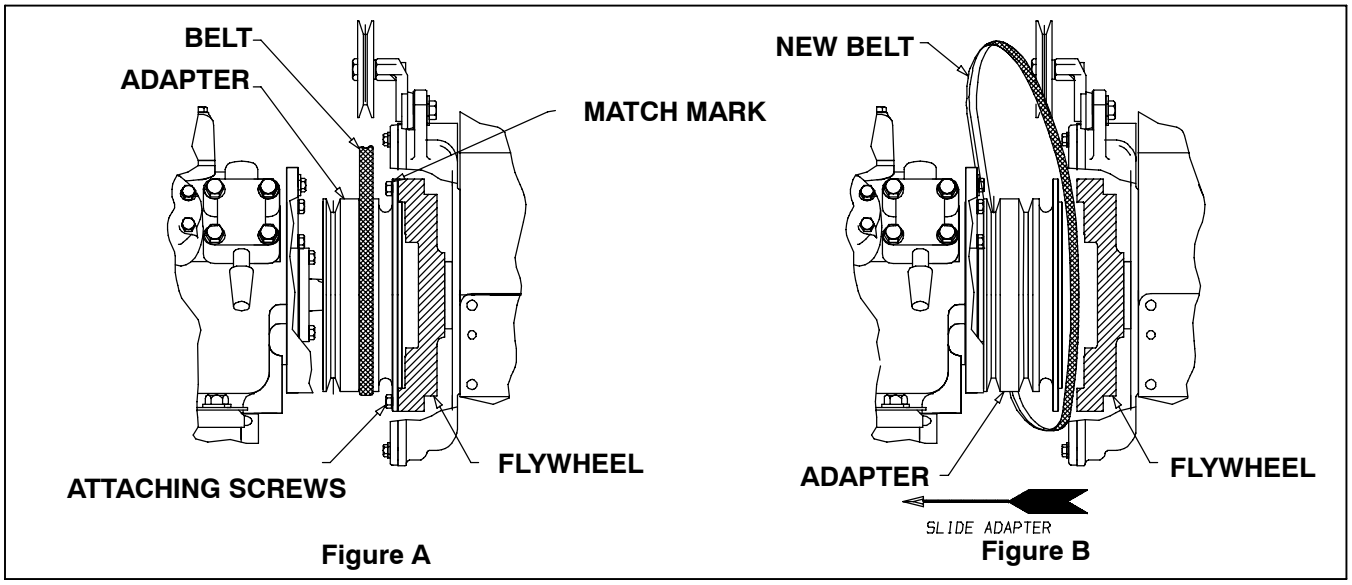


Figure 6-16. Removing V-Belt from Engine Adapter Drive Sheave

6.12 FANSHAFT ASSEMBLY – SEE Figure 6-18

⚠ WARNING

Beware of V-belts and belt driven components as the unit may start automatically. Before servicing unit, make sure the Run/Stop switch is in the STOP position or the unit is in Maintenance mode. Also disconnect the negative battery cable.

6.12.1 Clutch Removal

a. Place the Run/Stop switch in the STOP position and disconnect the negative battery cable.

b. Loosen the fan belt idler and remove upper drive belt.

c. Remove the top 8 bolts (4 along top and 2 down each side) that hold fan shroud to condenser frame.

d. Remove the 3 bolts that thread through the back of the clutch rotor/pulley forward into the condenser fan hub. Carefully remove the condenser fan & hub assembly from unit. (See Figure 6-18)

NOTE

The armature–retaining bolt is a LEFT HAND THREAD BOLT.

e. Remove the clutch armature. A standard 5/8-11 x 1" right hand thread bolt can be threaded through the center to jack the armature off the shaft.

f. Use spanner socket P/N 07-00303-02 to remove the spanner nut that secures the clutch rotor.

NOTE

The spanner nut is a LEFT HAND NYLOCK THREAD NUT.

g. Slide off and remove the clutch rotor/pulley. If the rotor will not slide off easily, remove the condenser fan hub adapter from the fan. Place the adapter backwards against the fanshaft hub, and thread three 5/16-18 x 2–3/4" long bolts from the back of the rotor forward into the hub adapter. Tighten the bolts evenly to pull the rotor off the fanshaft hub.

h. Unplug the clutch coil connector from the wiring harness, then remove the clutch coil. **Be sure to retain all shims on fanshaft hub, correctly positioned on fanshaft pin.**

6.12.2 Blower Wheel And Fanshaft Removal

a. Remove bulkhead and air chute (if equipped). Remove evaporator back panel.

b. Remove the bolts that secure the upper DTT mounting plate and SAS mounting clamp to the nozzle cover. Hang harness down out of way, using care to prevent cutting wires on evaporator coil.

c. Remove the remaining bolts in the nozzle cover and carefully remove it from the pod.

NOTE

The nozzle cover (P/N 58-04469-00) is sealed with a gasket (CTD P/N 42-00506-00). If the gasket is damaged during removal, it **MUST** be replaced.

d. Remove the two 1/4-20 X 1" lg. bolts from the blower wheel split-taper bushing. Insert them into the threaded holes. Tighten bolts evenly to push the blower wheel away from the bushing.

e. Remove blower wheel and bushing from fanshaft.

f. Remove the fan shaft seal ring clamp and carefully peel seal from pod (use a putty knife if needed).

NOTE

The fan shaft seal (CTD P/N 42-00372-00) is caulked to the pod. If seal is damaged during removal, it **MUST** be replaced.

g. Remove the four 3/8" bolts from the fan shaft.

h. Remove vent from fanshaft.

i. Remove fanshaft from unit.

j. Inspect key, keyway and shaft for wear.

6.12.3 Fanshaft Installation

a. Install key (included) into the shaft keyway.

NOTE

If it is necessary to drive the key into place, be sure to support the shaft while tapping the keys into place.

b. Position the fan shaft so that the housing is in the normal mounting position, with the shaft horizontal and the vent hole facing directly up. Remove both pipe plugs (1/8" NPT) from fan shaft.

c. Ensure that oil in the fan shaft is at proper level. If not, fill the fan shaft with oil (07-00373-00) until oil is at the bottom of the level hole on the bottom of the fanshaft (approximately 3 oz/89 ml). Apply pipe thread sealant to the pipe plug on the side of fan shaft housing and tighten. Reinstall pipe plug on hub to prevent oil spillage.

d. Install the fan shaft into the unit with the four fan shaft mounting bolts and torque bolts to 28 to 30 ft-lb (38 to 40.6 Nm), making sure the plug for the vent is pointing up.

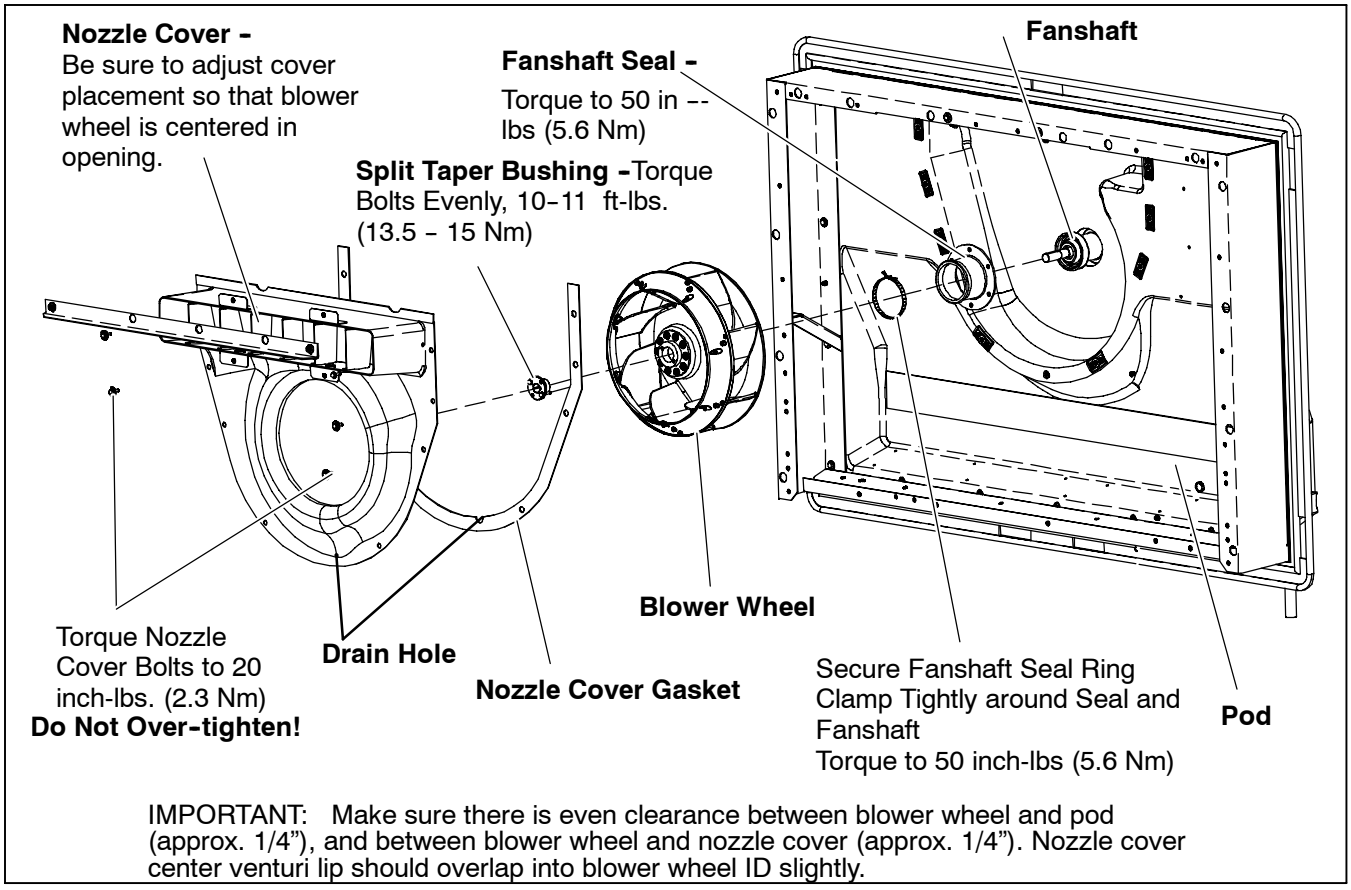

Nozzle Cover –
Be sure to adjust cover placement so that blower wheel is centered in opening.
Fanshaft Seal –
Torque to 50 in –- lbs (5.6 Nm)
Fanshaft
Split Taper Bushing –Torque Bolts Evenly, 10–11 ft-lbs. (13.5 – 15 Nm)
Blower Wheel
Torque Nozzle Cover Bolts to 20 inch-lbs. (2.3 Nm)
Do Not Over-tighten!
Drain Hole
Nozzle Cover Gasket
Secure Fanshaft Seal Ring Clamp Tightly around Seal and Fanshaft
Torque to 50 inch-lbs (5.6 Nm)
Pod
IMPORTANT: Make sure there is even clearance between blower wheel and pod (approx. 1/4"), and between blower wheel and nozzle cover (approx. 1/4"). Nozzle cover center venturi lip should overlap into blower wheel ID slightly.

Figure 6-18. Evaporator Blower Wheel and Nozzle Cover

NOTE

To aid in fan shaft alignment, install two 3/8"-16 x 1 1/2" studs (bolts with heads cut off) into the fan shaft mounting hub. Once the first two fan shaft mounting bolts are loosely installed, remove the studs and install bolts.

6.12.4 Blower Wheel Installation

a. Make sure the key is properly placed in the keyway. Slide blower wheel and bushing onto shaft.

b. Loosely attach blower wheel to bushing and slide assembly forward until blower wheel touches pod (this will set approximate clearance between blower wheel and pod).

c. Loosely attach the nozzle cover to pod with retaining bolts. Install SAS and mounting clamp with at least 1/2" of sensor protruding into the nozzle. Re-attach the klixon.

d. Slowly and evenly torque blower wheel bolts to 10–11 ft-lbs. (14 to 15 Nm)

e. Position nozzle cover so that blower wheel is centered in cover opening. Torque nozzle cover bolts to 20 inch-lbs (2.3 Nm).

f. Rotate blower wheel and check that clearance is approximately 1/4." Adjust nozzle cover and/or blower wheel if necessary.

g. Re-install evaporator panel, re-attach air chute and bulkhead (if equipped).

e. Apply pipe thread sealant to barb fitting and install into vent hole. Slide hose vent onto barb fitting.

f. Apply caulk to the fan shaft seal and place on the fan shaft. Place fan shaft seal ring clamp on seal and torque to 50 ft–lbs (68 Nm).

6.12.5 Clutch Installation

⚠ CAUTION

Do not get anti-seize oil/compound onto clutch contact surfaces. Thoroughly clean off oil/compound with contact or brake cleaner if this occurs.

NOTE

Starting with the 50-00236-05 clutch, the orientation of the clutch coil **MUST** be on the bottom. Secure the harness to the lower right fan shaft mounting bolt using the cushion clamp provided.

a. Place clutch coil onto fanshaft hub, with coil harness on bottom. **Make sure all original shims are correctly positioned on fanshaft pin**, and then slide coil onto hub so fanshaft pin fits into notch in coil.

NOTE

The fanshaft pin is used to position the coil to properly locate the wire harness to the frame.

b. Install rotor spacer and rotor onto the fanshaft.

c. Install the new spanner nut (included in mounting accessory kit (CTD P/N 50-00236-21.) Use CTD spanner socket 07-00303-02 and torque to 80-85 ft-lbs (108 to 115 Nm.)

NOTE

The spanner nut is a **LEFT HAND NYLOCK THREAD NUT.**

d. Slide the armature into place on the fanshaft, making sure the key is in place and the keyway lines up correctly with the shaft key.

e. Install the new armature retaining bolt and washer. Use spanner wrench P/N 07-00396-01 (at the 2 o'clock position) to hold the armature, then torque the retaining bolt to 25 to 30 ft-lbs. (34 to 41 Nm)

NOTE

The armature-retaining bolt is a **LEFT HAND THREAD BOLT.**

f. Measure the clutch air gap with the air gap tool (07-000432-00). The gap should be between 0.015" and 0.090" (0.38 and 2.29 mm). If it is not, remove the entire clutch. If the gap is less than 0.015", remove one of the fanshaft hub shims. If the gap is greater than 0.090", add enough shims to reduce the gap to approximately. 0.020" (shims are 0.010" each, CTD P/N 50-00232-30). Re-install clutch assembly.

g. Reinstall upper drive belt.

h. Re-attach the condenser fan (and hub assembly if applicable) to the clutch rotor. Thread the 3 bolts from behind the clutch rotor into the condenser fan hub, and torque the bolts to 18 to 22 ft-lbs (24 to 30 Nm).

i. Re-install fan shroud, if applicable and the upper drive belt and adjust idler to attain a belt tension of 70 to 80 ft-lbs (95 to 108 Nm).

j. Remove condenser fan shroud spacers/supports that may have been inserted. Re-install upper 8 bolts that hold shroud to condenser frame.

k. Plug the clutch coil connector back into the wiring harness. Tie-wrap harness as needed to secure.

l. Re-connect negative battery cable.

m. Check unit for proper clutch operation.

⚠ WARNING

Do not start unit without installing the evaporator panels as unit damage or body harm may result.

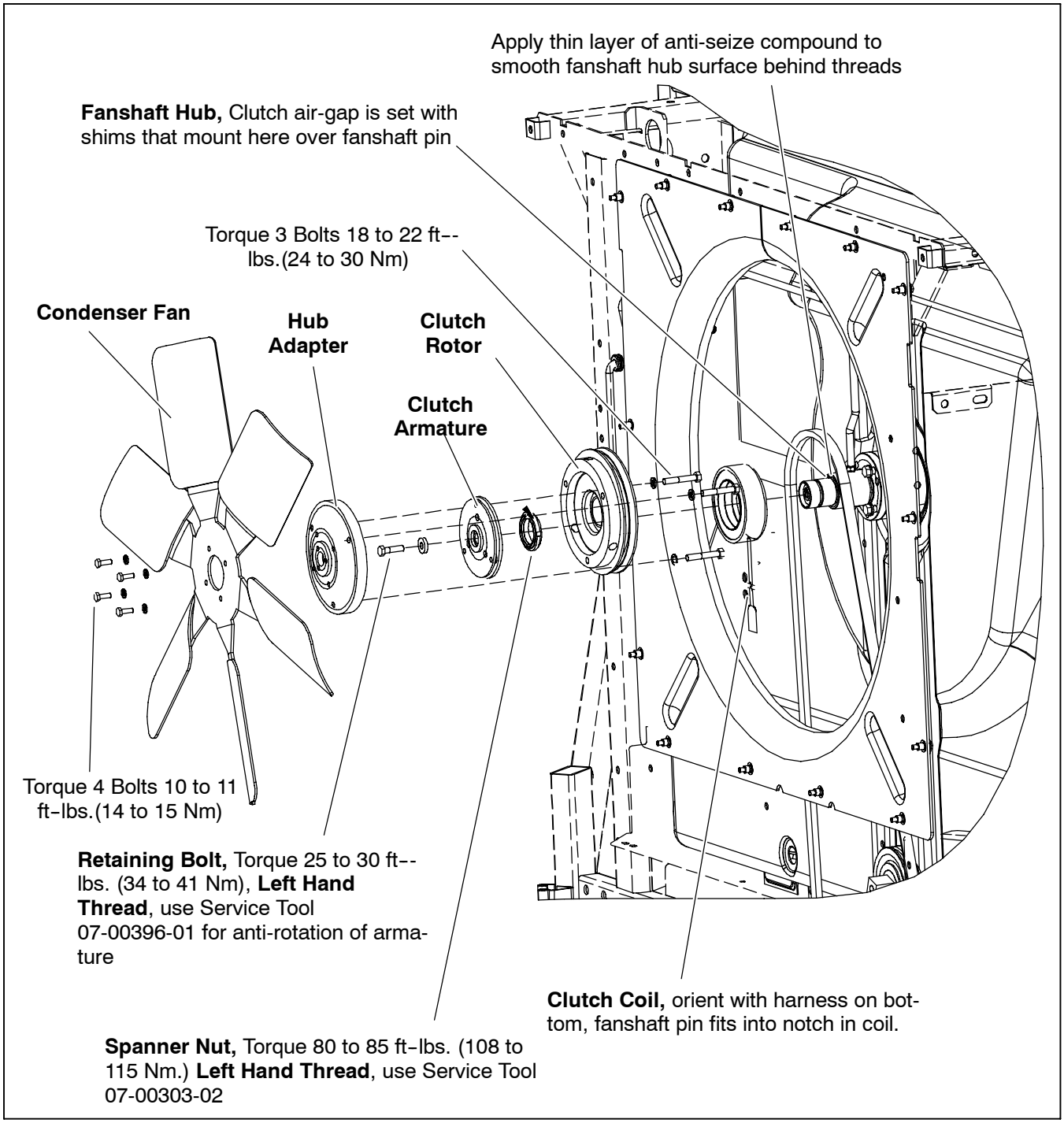

Apply thin layer of anti-seize compound to smooth fanshaft hub surface behind threads
Fanshaft Hub, Clutch air-gap is set with shims that mount here over fanshaft pin
Torque 3 Bolts 18 to 22 ft-- lbs.(24 to 30 Nm)
Condenser Fan
Hub Adapter
Clutch Rotor
Clutch Armature
Torque 4 Bolts 10 to 11 ft–lbs.(14 to 15 Nm)
Retaining Bolt, Torque 25 to 30 ft-- lbs. (34 to 41 Nm), **Left Hand Thread**, use Service Tool 07-00396-01 for anti-rotation of armature
Clutch Coil, orient with harness on bottom, fanshaft pin fits into notch in coil.
Spanner Nut, Torque 80 to 85 ft–lbs. (108 to 115 Nm.) **Left Hand Thread**, use Service Tool 07-00303-02

Figure 6-19. Condenser Fan and Clutch

6.13 CHECKING THE REFRIGERATION SYSTEM

This refrigeration troubleshooting procedure is designed to test the major components used in this Carrier Transicold trailer refrigeration unit. This procedure, designed primarily to test the system's mechanical components, can also point out many electrical problems. A sound knowledge of electrical and refrigeration fundamentals and Carrier Transicold heat, cool and defrost cycle operations is essential to perform this procedure.

NOTE

The following troubleshooting procedures are designed to test the major components used in trailer refrigeration units using R-404a. The following rules MUST be followed to ensure accurate results:

a. All directions for each step must be read through and thoroughly understood by the service technician *before* beginning that step.

b. Each step must be successfully completed in sequence.

c. Any problems found must be repaired immediately and the step repeated before continuing the procedure unless otherwise noted.

d. Equipment must be operated in High Speed Cool for 20 minutes prior to starting this procedure

Operate with a 35°F (1.7°C) setpoint, fully loaded [unplug both unloaders when box temperature reaches 35°F (1.7°C)]. This action allows the compressor oil to come up to operating temperature. When these conditions are met, plug in both unloaders.

e. The ambient (air entering the condenser) air temperature should be above +60°F (15.6°C).

NOTE

Ambient temperatures below 60°F (15.6°C) could cause inaccurate results in any step of this procedure.

f. On units with automatic start/stop the microprocessor must be set for "MAN OP" and "CONTINUOUS RUN" operation and left in this mode during the entire test.

The following tools are required to perform this procedure:

1. Refrigeration Ratchet
2. Refrigeration manifold gauge set (2 required)
3. 5 feet square plastic sheet (2-4 mil)
4. 8 – 10 inch adjustable end wrench
5. Wire cutters
6. DC volt ohm meter
7. 07-50006-00 Quick Check Jumper Kit which includes:

(1) Coil Tester (2-wire plug with 24" wire leads and spring clips)
(1) Circuit Tester (male and female 2-wire plugs wired together with bare wire for volt age test)
(1) Bypass plug (2-wire plug with jumper loop
(1) 4' jumper wire with spring clips

Before starting test, install a manifold gauge set on compressor service valve gauge ports, and a second manifold gauge set with the high pressure gauge connected to the king valve. All gauge lines must be purged of air which could enter the system.

The procedure may now be started. It may be helpful to refer to the refrigeration flow diagram (Section 2.16) when following this procedure.

6.13.1 Checking Refrigerant Charge and High Ambient Compressor Operation

a. Start the unit [setpoint at 11°F (-11.7°C)]. Allow the unit to run until the engine reaches high speed. [The engine may start in low speed and remain there for 15 seconds or until the engine coolant temperature reaches 78°F (25.6°C)]. Partially cover the condenser to raise the discharge pressure to 260 – 280 PSIG (17.7 – 19.1 Bar).

b. Check the receiver tank sight glasses for proper refrigerant charge. See Section 6.17. for differences in receiver sight glasses.

c. See Section 6.17 for instructions on adding refrigerant to the system.

d. Cover the condenser further to raise the discharge pressure to 350 – 375 psig (23.8 – 25.5 Bar). This ensures that the compressor can achieve sufficient discharge pressure to operate in high ambient temperatures. (It may be necessary to unplug the front unloader).

e. Uncover the condenser. The unit should be left running in High Speed Cool.

6.13.2 Compressor Unloader Valve Operation - Units With Individual Wires Connected To The Unloaders:

a. With the unit still running in High Speed Cool, remove the white positive wire from the unloader coil(s).

b. Note the suction pressure.

c. Using a jumper wire attached to the positive starter or battery post, apply 12 VDC to the front unloader coil terminal. The suction pressure should rise noticeably [approx. 5 - 10 psig (0.34 - 0.68 Bar)].

NOTE

If no change in suction pressure occurs, check the unloader coil ground connection and the coil resistance before making any repairs to the unloader solenoid valve.

d. Remove the jumper wire and the suction pressure should drop.

e. Repeat steps c. & d. to cycle the unloader 3 - 4 times to verify consistent operation.

f. Repeat steps b. to e. to check the rear unloader.

g. See Sections 6.20.2 and 6.20.3 for unloader repair.

h. Reconnect the unloader wires.

i. Leave the unit running in High Speed Cool.

6.13.3 Compressor Unloader Valve Operation - Units With Unloaders Plugged Into the Wiring Harness

a. With the unit still running in High Speed Cool, unplug the unloader coil(s) from the wire harness.

b. Note the suction pressure.

c. Plug the front unloader wires into the coil tester.

d. Connect the black test lead to a good ground (negative) connection.

e. Momentarily connect the white test lead to the positive starter or battery post, apply 12 VDC to the front unloader coil terminal. The suction pressure should rise noticeably [approx. 5 - 10 psig (0.34 - 0.68 Bar)].

NOTE

If no change in suction pressure occurs, check the unloader coil ground connection and the coil resistance before making any repairs to the unloader solenoid valve.

f. Remove the white lead from the positive starter or battery post and the suction pressure should drop.

g. Repeat steps e. & f. to cycle the unloader 3 - 4 times to verify consistent operation.

h. Repeat steps b. to e. to check the rear unloader.

i. Reconnect the unloader wires.

j. Leave the unit running in High Speed Cool.

6.13.4 SV-4 And By-Pass Check Valve Seating Ability During Cool

a. Slowly frontseat the king valve (receiver tank outlet valve) and pump down the low side of the system to 0 psig. **Do not allow the system to run in vacuum.**

b. Shut off unit and observe the suction and discharge pressures at the compressor. They should not equalize in less than 30 seconds. If they do, it will indicate:

1. The by-pass check valve is leaking.

2. Internal leakage inside the compressor - unloader valves, reed valves or head gaskets.

3. SV-4 is leaking and not properly seated.

NOTE

This problem can be verified by carefully feeling the refrigerant lines for hot/cold spots, or by listening for internal leakage.

c. Any leakage, internal or external, found while performing this step MUST be repaired before continuing.

d. The unit should be OFF at the end of this step.

6.13.5 Discharge Line Check Valve Leakage, & SV-2 Seating & Opening Ability

a. Midseat (open) the hand valves on the manifold gauge set connected to the compressor. This action will allow the high pressure refrigerant in the discharge line to bleed to the low side of the system, and the gauge readings will balance out.

b. After a short time (10-15 seconds), frontseat (close) the hand valves on the manifold gauge set connected to the compressor and observe the high side gauge. A continuous rise in pressure would indicate that the Discharge Check Valve is allowing pressure to leak back into the compressor.

NOTE

If the check valve is leaking internally, it does not have to be repaired until after completing this procedure. It will have no effect on the remaining steps. See Section 6.26.1.

c. Very slowly open the king valve to allow refrigerant to pass through the filter-drier to the liquid line solenoid valve (SV-2). Bring the king valve to the midseat position. SV-2 should remain closed and there should be no rise in suction pressure. A rise in suction pressure indicates that SV-2 is leaking and not properly seated. See Section 6.26.1.

d. Place the Run/Stop switch in the RUN position. Observe the suction pressure gauge. After 5 seconds SV–2 will energize and open, causing the suction pressure to rise to a maximum pressure of the MOP setting of the TXV.

e. If the suction pressure does not rise, it could indicate a restricted or blocked liquid line or TXV valve. Check to be sure that the SV–2 is energized and open.

NOTE

This step does not check the superheat setting or the MOP of the expansion valve. Superheat must be done separately as outlined in Section 6.23.

f. The unit should be OFF at the end of this step.

6.13.6 HP–2 and SV–2 for Cycling During Heat and Defrost

For Units With Individual Wires Connected To the Unloaders and SV–2

a. Disconnect the white (positive) wire from the unloaders.

b. Adjust setpoint to 77°F (25°C) or higher and start the unit. The unit will run in low speed for 15 seconds, then go into High Speed Heat. (It may be necessary to place the unit in High Airflow so that the engine will run in high speed).

c. Connect a voltmeter to the positive terminal of SV-2 (refer to wiring schematic if necessary – Refer to Section 7) leaving all wires to both HP-2 and SV-2 connected. Observe the voltmeter and compressor discharge gauge readings. The compressor discharge pressure will rise because SV-1 should be closed, with only SV-4 open. When the discharge pressure rises to 300 psig (20.4 Bar), the HP-2 switch contacts will open causing SV-2 to close. This can be seen by the voltmeter reading dropping to 0 VDC, and the compressor discharge pressure decreasing. When the discharge pressure drops to 200 psig (13.6 Bar), the HP-2 switch contacts will close and open SV-2 causing the discharge pressures to rise and 12 VDC to show on the voltmeter. This action shows proper cycling of SV-2 by HP-2. Immediately reconnect the wire to SV–3. (The HP-2/SV-2 cycling interval will depend on the ambient and box temperatures)

d. Refer to Section 6.26.1 for information on repairing SV–2 and Section 6.24.1 to replace HP–2.

e. Reconnect wire to front unloader, and make sure wires to SV–2 are on coil.

f. The unit should be “OFF” at the end of this step.

NOTE

This procedure does not check the actual settings for the HP-2 switch. If the switch opens and closes within 15 – 20 psig of the rated settings, the switch is functioning properly. To actually determine the opening and closing settings of the switch, refer to Section 2.12

For Units With The Unloader(s) and SV–2 Plugged Into the Wire Harness:

a. Unplug the front unloader from the wire harness, and remove the white wire from SV–3 valve.

b. Unplug SV–2 and connect the circuit tester between the wire harness and the SV–2 valve.

c. Adjust setpoint to 77°F (25°C) or higher and start the unit. The unit will run in low speed for 15 seconds, then go into High Speed Heat. (It may be necessary to place the unit in High Airflow so that the engine will run in high speed).

d. Connect a voltmeter to the circuit tester wires at SV-2. Observe the voltmeter and compressor discharge gauge readings. The compressor discharge pressure will rise because SV-1 should be closed, with only SV-4 open. When the discharge pressure rises to 300 psig (20.4 Bar), the HP-2 switch contacts will open causing SV-2 to close. This can be seen by the voltmeter reading dropping to 0 VDC, and the compressor discharge pressure decreasing. When the discharge pressure drops to 200 psig (13.6 Bar), the HP-2 switch contacts will close and open SV-2 causing the discharge pressures to rise and 12 VDC to show on the voltmeter. This action shows proper cycling of SV-2 by HP-2. Immediately reconnect the wire to SV–3. (The HP-2/SV-2 cycling interval will depend on the ambient and box temperatures)

e. Remove circuit tester from SV–2 valve, plug front unloader back into wire harness, and make sure the wires to the SV–3 valve are properly connected.

f. The unit should be “OFF” at the end of this step.

NOTE

This procedure does not check the actual settings for the HP-2 switch. If the switch opens and closes within 15 – 20 psig of the rated settings, the switch is functioning properly. To actually determine the opening and closing settings of the switch, refer to Section 2.12

6.13.7 SV-1 for Seating, Sv-4 for Opening

For Units With Individual Wires Connected To the Unloaders and SV-2

a. Unplug the wire harness from the engine oil pressure switch, and install the bypass jumper plug into the wire harness.

b. Remove the white wire from SV-4 front unloader and 1 wire from the HP-2 switch.

c. Readjust setpoint to 20° to 25° F (11° to 14° C) above box temperature (high speed heat operation). (It may be necessary to run the unit in "COOL" prior to this step.)

d. Start the unit. Allow the unit to run for 30 to 45 seconds. The suction pressure should fall to approximately 0 psig, and the receiver pressure to near or below 200 psig (13.6 Bar). Closely monitor both high pressure gauges while connecting the wire to the HP-2 switch. Compressor discharge pressure will begin to rise. Receiver pressure should not rise. When the compressor discharge pressure reaches 390 psig (26.6 Bar), shut the engine off using the engine stop lever near the injection pump. (The microprocessor will remain energized.) The compressor discharge pressure will drop off, but the receiver pressure should not change. Any rise in receiver pressure indicates internal leakage at the SV-1 valve.

e. Observe the suction gauge. Using a jumper wire, momentarily energize SV-4 by clipping one end to the post on SV-4 and toughing the other end to the positive (+) starter post or battery post. The valve should open and the suction pressure begin to rise. Remove the jumper and observe. The valve should close, and the suction pressure should stop rising. Energize the valve 2 or 3 times to verify consistent valve operation.

f. Reconnect the unit's harness wires to SV-4 and the front unloader. Remove the bypass plug from the wire harness and reconnect harness to the engine oil safety switch.

g. The unit should be "OFF" at the end of this step.

For Units With Unloaders, HP-2 and SV-3 Plugged Into the Wire Harness:

a. Unplug the wire harness from the engine oil pressure safety switch, and install the bypass jumper plug in the wire harness.

b. Unplug the Front Unloader and the HP-2 switch.

c. Unplug the wiring harness from SV-4, and install the coil tester. Connect the black wire to a good ground. Clip the white wire onto an insulated portion of the black wires so it does not touch any metal.

d. Re-adjust set point to 20 - 25°F (11° to 14° C) above box temperature (high speed heat operation). (It may be necessary to run the unit in "COOL" prior to this step.)

e. Start the unit. Allow the unit to run 30 to 45 seconds. The suction pressure should fall to approximately 0 psig, and the receiver pressure near or below 200 psig (13.6 Bar). Closely monitor both high pressure gauges while connected the wire to the HP-2 switch. Compressor discharge pressure will begin to rise. Receiver pressure should not rise. When the compressor discharge pressure reaches 390 psig (26.6 Bar), shut the engine off using the engine stop lever near the injection pump. (The microprocessor will remain energized.) The compressor discharge pressure will drop off, but the receiver pressure should not change. Any rise in receiver pressure indicates internal leakage at the SV-1 valve.

f. Observe the suction gauge. Momentarily energize SV-4 by connecting the white wire of the coil tester to the positive (+) starter post or battery post. The valve should open and the suction pressure begin to rise. Remove the wire and observe the pressures. The valve should close, and the suction pressure should stop rising. Energize the valve 2 to 3 times to verify consistent valve operation.

g. Reconnect unit harness wires to SV-4, front unloader, and remove the bypass plug from the wire harness, and reconnect harness to the engine oil safety switch.

h. The unit should be "OFF" at the end of this step.

6.13.8 SV-1 Defrost Operation

a. Place the unit into defrost manually.

b. Make sure the unit goes into defrost properly and the engine is running in High Speed.

NOTE

If the ambient temperature sensor is above 100°F (37.8° C), the high ambient defrost cycle may be initiated.

c. Check that the fan clutch has disengaged and the fan shaft is not turning.

d. The unit should come out of defrost automatically. The engine will shift to low speed, engage the fan clutch, and resume High Speed Cool.

6.13.9 Removing the Refrigerant Charge

NOTE

Store the refrigerant charge in an evacuated container if the system must be opened between the compressor Discharge Service Valve and Receiver Outlet (King) Valve.

Whenever the system is opened, it must be evacuated and dehydrated. (Refer to Section 6.16)

⚠ WARNING

Do not use a disposable refrigerant container to store the charge as an explosion may occur.

Equipment Required

a. Appropriate returnable refrigerant cylinder, preferably 125lb (57 kg) net capacity. Also, a 50 lb. (23 kg) capacity returnable cylinder may be used. Refrigerant removal will be faster and more complete with the larger cylinder.

b. Refrigerant manifold gauge set.

c. Vacuum pump, preferably 5 cfm ($8m^3H$),

P/N 07-00176-01.

d. Weight scales (0 to 300 lb. (0 to 91 kg) range, minimum).

e.A 12 foot length of 3/8 " (I.D.) evacuation hose or 3/8" copper tubing with 3/8" female flare adapter on each end. Do not use hose or tubing of smaller diameter or the removal process will take considerably longer.

6.13.10 Refrigerant Removal From An Inoperative Compressor.

To remove the refrigerant from a compressor that is not operational, do the following:

a. Recover refrigerant with a refrigerant reclaimer.

b. Service or replace components as required and leak check the entire system.

c. Using refrigerant hoses designed for vacuum service, connect a vacuum pump to center connection of manifold gauge set. Evacuate compressor to or below 500 microns. Close off pump valve, isolate vacuum gauge and stop pump. Wait 5 minutes to verify that vacuum holds at or below 500 microns.

d. Once vacuum is maintained, recharge high side with R-404a to proper charge. Backseat compressor service valves and disconnect manifold gauge set.

6.13.11 Refrigerant Removal From An Operable Compressor

To service an operable compressor, pump the refrigerant into the condenser coil and receiver as follows:

a. Frontseat the compressor suction service valve by turning clockwise.

b. Start the unit and run in cooling until a slight vacuum (1–2") is reached. Shut the system down and tag out system power source.

c. Frontseat the compressor discharge service valve and wait 5 minutes to verify vacuum is maintained. If the pressure rises above vacuum, open the compressor discharge service valve and repeat steps b. and c. until a vacuum is maintained.

d. Service or replace compressor components as required and leak check the entire system.

e. Using refrigerant hoses designed for vacuum service, connect a vacuum pump to center connection of manifold gauge set. Evacuate system to to below 500 microns. Close off pump valve, isolate vacuum gauge and stop pump. Wait 5 minutes to verify that vacuum holds at or below 500 microns.

NOTE

Refrigerant will flow from the system into the evacuated cylinder until system pressure is equivalent to container temperature. For example, if a cylinder is at 90°F (32.2°C), given a system containing R–404A, the system pressure reaches 204 psig (13.9 Bar) no further transfer will take place. (For this reason, it is possible to remove only approx. 77 – 83 % of refrigerant by this method).

NOTES

1. It is good practice to place a USED REFRIGERANT tag on cylinder.
2. Install a drier in the charging line when recharging this refrigerant into the system if there is the slightest possibility that moisture had entered the system.

6.14 PUMPING DOWN THE UNIT OR REMOVING REFRIGERANT CHARGE

NOTE

To avoid damage to the earth's ozone layer, use a refrigerant recovery system whenever removing refrigerant. When working with refrigerants you must comply with all local government environmental laws, U.S.A. EPA section 608.

Whenever the system is opened, it must be evacuated and dehydrated. (Refer to Section 6.16)

6.14.1 Pumping Down The Unit

In order to service the components downstream of the king valve (and back to the compressor), the unit can be pumped down in the standard manner:

a. Backseat suction and discharge service valves (turn counterclockwise) to close off gauge connection and attach manifold gauges to service valves.

b. Open valves two turns (clockwise). Purge manifold gauge lines.

c. Frontseat the receiver manual shut-off valve (king valve) by turning clockwise. Start unit and run in cooling mode. Place the Run/Stop switch in the STOP position when compressor suction pressure approaches 1 PSIG (0.07 Bar).

⚠ CAUTION

Do not allow suction pressure to go below 0 Psig/Bar.

d. If the compressor does not pump down to 1 PSIG (0.07 Bar) there may be a problem with the compressor reed valves or other internal components. See Section 6.18.

e. Frontseat (close by turning clockwise) suction service valve and the refrigerant will be trapped between the compressor suction service valve and the manual shut-off valve (king valve).

f. Check the manifold gauge pressure prior to opening the refrigeration system. If the pressure rises, the discharge check valve may be leaking refrigerant back into the system. Check and replace if necessary. See Section 6.21

g. Before opening up any part of the system, a slight positive pressure should be indicated on the pressure gauge.

4. When opening up the refrigerant system, certain parts may frost. Allow the part to warm to ambient temperature before dismantling. This avoids internal condensation, which puts moisture in the system.

5. After making necessary repairs, leak test and evacuate the low side of the refrigeration system. (Refer to Sections 6.15 and 6.16.)

6.Backseat manual shut-off valve (king valve) and midseat suction service valve.

h. Start the unit in cooling and check for noncondensibles.

i. Check the refrigerant charge. (Refer to Section 6.17.1.)

NOTE

Store the refrigerant charge in an evacuated container if the system must be opened between the compressor discharge valve and receiver. Whenever the system is opened, it must be evacuated and dehydrated. (Refer to Section 6.16)

6.15 REFRIGERANT LEAK CHECKING

a. If the system was opened and repairs completed, leak check the unit.

b. The recommended procedure for finding leaks in a system is with a electronic leak detector. **(A halide torch will not work on units with HFC refrigerants, such as R-404A)**. Testing joints with soapsuds is satisfactory only for locating large leaks, or pinpointing small leaks once a general area has been located.

c. If the system is without refrigerant, charge system with refrigerant to build up pressure between 30 to 50 psig (2.04 to 3.4 Bar). Remove refrigerant drum and leak check all connections.

⚠ CAUTION

Only a refrigerant drum containing R404a should be connected to an XT refrigeration unit in order to pressurize the system. Any other gas or vapor will contaminate the system which will require additional purging and evacuation of the high side (discharge) of the system.

d. Remove refrigerant using a refrigerant recovery system and repair any leaks. Evacuate and dehydrate the unit. (Refer to Section 6.16) Charge unit with refrigerant. (Refer to Section 6.17)

6.16 EVACUATION AND DEHYDRATION

6.16.1 General

Moisture is the enemy of refrigerant systems. The presence of moisture in a refrigeration system can have many undesirable effects. The most common are copper plating, acid sludge formation, “freezing-up” of metering devices (TXV) by free water, and formation of acids, resulting in metal corrosion.

6.16.2 Preparation

a. Evacuate and dehydrate only after pressure leak test. (Refer to Section 6.15)

b. Essential tools to properly evacuate and dehydrate any system include a good vacuum pump (5 cfm (8m3H) volume displacement, P/N 07-00176-11) and a good vacuum indicator such as a thermocouple vacuum gauge (vacuum indicator, P/N 07-00414-00).

NOTE

Do not use a manifold gauge because of its inherent inaccuracy.

c. Keep the ambient temperature above 60°F (15.6°C) to speed evaporation of moisture. If ambient temperature is lower than 60°F (15.6°C), ice might form before moisture removal is complete. Heat lamps or alternate sources of heat may be used to raise system temperature.

6.16.3 Procedure for Evacuation and Dehydrating System

NOTE

Standard service hoses are not suitable for evacuation purposes.

a. Remove refrigerant using a refrigerant recovery system.

b. The recommended method to evacuate and dehydrate the system is to connect three evacuation hoses as shown in Figure 6-19 to the vacuum pump and refrigeration unit. Also, as shown, connect an evacuation manifold, with evacuation hoses only, to the vacuum pump, electronic vacuum gauge, and refrigerant recovery system.

c. With the unit service valves closed (back seated) and the vacuum pump and electronic vacuum gauge valves open, start the pump and draw a deep vacuum. Shut off the pump and check to see if the vacuum holds. This operation is to test the evacuation setup for leaks, repair if necessary.

d. Midseat the refrigerant system service valves.

e. Open the vacuum pump and electronic vacuum gauge valves, if they are not already open. Start the vacuum pump. Evacuate unit until the electronic vacuum gauge indicates 2000 microns. Close the electronic vacuum gauge and vacuum pump valves. Shut off the vacuum pump. Wait a few minutes to be sure the vacuum holds.

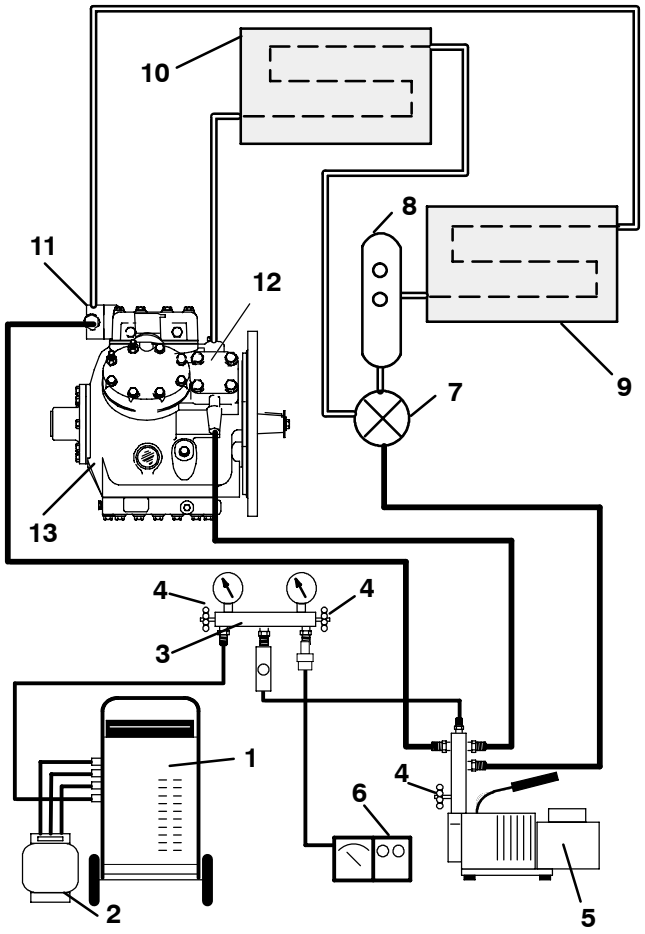
f. Break the vacuum with dry nitrogen. Raise system pressure to approximately 2 PSIG (0.14 Bar).

g. Purge nitrogen from system.

h. Repeat steps e through g one time.

i. Evacuate unit to 500 microns. Close off vacuum pump valve and stop pump. Wait five minutes to see if vacuum holds. This checks for residual moisture and/-or leaks.

j. With unit still in a vacuum, the refrigerant charge may be drawn into the system from a refrigerant container on weight scales. The correct amount of refrigerant may be added by observing the scales. (Refer to Table 2-1)



1. Refrigerant Recovery Unit
2. Refrigerant Cylinder
3. Evacuation Manifold
4. Valve
5. Vacuum Pump
6. Vacuum Gauge
7. King Valve
8. Receiver
9. Condenser
10. Evaporator
11. Discharge Service Valve
12. Suction Service Valve
13. Compressor

Figure 6-19. Vacuum Pump Connection

6.17 ADDING REFRIGERANT TO SYSTEM

⚠ CAUTION

Do not vapor charge R-404A. Only liquid charging through the receiver (king) valve is acceptable.

6.17.1 Checking The Refrigerant Charge

NOTE

High speed operation at some conditions may create high turbulence inside the receiver. If it is difficult to see the refrigerant settling properly in the receiver sight glass, unplug the speed solenoid, forcing low speed operation. There should be less turbulence in the receiver and the liquid refrigerant should settle properly.

Checking Refrigerant Level on Units With S/N Prior to JAR90710713

NOTE

The ambient (air entering the condenser) air temperature should be above 40°F (4.4°C)

1) Start unit in cooling mode. Run approximately ten minutes – until the refrigeration system is warmed up and the box temperature is less than 45°F (7.2C).
2) Partially block off air flow to condenser coil so discharge pressure rises to 230 PSIG (15.65 Bars).
3) Check the lower sight glass on the receiver to determine charge. The system is correctly charged when refrigerant level is at centerline of sight glass, then weigh in another 3 lbs (1.4 kg) of refrigerant.

Checking Refrigerant Level on Units With S/N Beginning With JAR90710713

NOTE

The ambient (air entering the condenser) air temperature should be above 40°F (4.4°C)

1) Start unit in cooling mode. Run approximately ten minutes – until the refrigeration system is warmed up and the box temperature is less than 45°F (7.2C).
2) Partially block off air flow to condenser coil so discharge pressure rises to 230 PSIG (15.65 Bar).
3) Check the lower sight glass to determine charge. The system is correctly charged when refrigerant level is at centerline of lower sight glass.

NOTE

The lower sight glass should not be empty and the upper sight glass should not be full.

4) If the system appears to be overcharged: Remove refrigerant through the king valve to correct refrigerant level.
5) If the refrigerant system appears to be undercharged: Add refrigerant through the king valve.

6.17.2 Adding A Partial Charge

⚠ CAUTION

Do not vapor charge R-404A. Only liquid charging through the receiver (king) valve is acceptable.

NOTE

The ambient (air entering the condenser) air temperature should be above 40°F (4.4°C)

a. Place drum of refrigerant on scale and note weight. Backseat discharge and suction service valves and install a manifold gauge set. Purge lines. Connect a second manifold test set discharge gauge to the king valve. Connect the suction pressure hose to manifold dead head port. Connect a charging line between the center tap of the second gauge set and refrigerant drum. Open the LIQUID valve on drum and purge all hoses.
b. Start the unit. Adjust the setpoint so that the unit will run in high speed cool mode.
c. Run the unit for approximately ten minutes – until the refrigeration system is warmed up and the box temperature is less than 45°F (7.2C) and then partially block off air flow to condenser coil so discharge pressure will rise 10 PSIG (0.68 Bar).
d. Check the appropriate sight glass to determine charge. (See Step g. for determination of charge.) If undercharged proceed with step e.
e. Frontseat the king valve, and monitor the second set of manifold gauges. When the king valve pressure drops below the pressure in the refrigerant drum, open the manifold gauge set discharge valve and allow liquid refrigerant to flow into the system.
f. While monitoring the appropriate sight glass, carefully weigh the refrigerant into the system. Because the unit is in this charging state, it is not possible to accurately determine when the system is full. Therefore, never allow more than 3 lbs (1.4 kg) of refrigerant into the system at a time.
g. After metering 3 lbs (1.4 kg) of refrigerant into the system, close the valve of the manifold gauge set connected to the King Valve. Open the king valve, partially block the air flow to the condenser coil and allow the system to balance out (approximately 4–5 minutes and the box temperature is less than 45°F (7.2C). Check sight glass(es) to determine charge:

   Units With S/N Prior to JAR90710713 – Once the refrigerant level is at centerline of the lower sight glass, weigh in another 3 lbs (1.4 kg) of refrigerant.

   Units With S/N Beginning With JAR90710713 – Charge the system until the refrigerant level is at centerline of the lower sight glass. **THE LOWER SIGHT GLASS SHOULD NOT BE EMPTY AND THE UPPER SIGHT GLASS SHOULD NOT BE FULL.**
h. Start unit and check for noncondensibles. (Refer to Section 6.25.1).

6.17.3 Adding A Full Charge

⚠ CAUTION

Do not vapor charge R-404A. Only liquid charging through the receiver (king) valve is acceptable.

a. Dehydrate unit to 500 microns and leave in deep vacuum. (Refer to Section 6.16)

b. Place drum of refrigerant on scale and connect charging line from drum to king valve. Purge charging line at king valve.

c. Note weight of drum and refrigerant.

d. Open liquid valve on drum. Midseat king valve and allow the liquid refrigerant to flow into the unit until the correct weight of refrigerant has been added as indicated by scales. Correct charge will be found in Table 2-1.

NOTE

It is possible that all liquid may not be pulled into the receiver, as outlined in step d. In this case, frontseat the receiver valve (king valve) and run the unit in cooling until the correct amount of refrigerant is added.

e. When scale indicates that the correct charge has been added, close liquid line valve on cylinder and backseat the king valve. Remove charging hose.

f. Start unit and check for noncondensibles. (Refer to Section 6.25.1).

6.18 REPLACING THE COMPRESSOR

NOTES

The service replacement compressor is sold without shutoff valves (but with valve pads). The valve pads should be installed on the removed compressor prior to return shipping. Customer should retain the original capacity control valves for use on replacement compressor. Check oil level in service replacement compressor. (Refer to Sections 2.11, and 6.19)

If compressor is inoperative and unit still has refrigerant pressure, frontseat suction and discharge service valves to trap most of the refrigerant in the unit.

If compressor runs, pump down the unit. (Refer to Section 6.13.11)

If compressor does not operate, frontseat both suction and discharge service valves, and remove refrigerant charge from compressor (Refer to Section 6.13.9.)

a. Disconnect the negative battery cable.

b. Slowly release compressor pressure to a recovery system.

c. Verify that all refrigerant has been pumped from compressor.

d. Remove the two rear compressor bracket mounting bolts (compressor shockmount end).

e. Block up engine.

f. Remove bolts from suction and discharge service valve flanges.

g. Remove oil filter and bracket from O5G compressor where applicable.

h. Loosen lower belt idler and remove belt from gearbox.

i. Remove the 6 bolts that secure the engine drive sheave adapter.

j. Slide the engine drive adapter from the engine.

k. Disconnect wiring to unloader valve assemblies, compressor discharge temperature sensor (CDT), suction pressure transducer and the wiring to the high pressure cutout switches (HP-1 and HP-2). Identify wiring and switches if necessary. (See Figure 6-21)

l. Remove 10 bolts from the engine-compressor spacer.

m. Disconnect ground strap from frame.

n. Disconnect suction pressure transducer from compressor .

o. Attach sling or other device to the compressor.

p. Slide compressor enough to clear bell housing of engine and remove compressor from unit.

q. Once compressor is on table, inspect the nylon drive assembly for wear, sharp edges. Replace if needed. (See Figure 6-20).

r. Drain oil from defective compressor before shipping.

s. The original unloader valves must be transferred to the replacement compressor. The plug arrangement removed from the replacement is installed in the original compressor as a seal. If piston is stuck, it may be extracted by threading socket head cap screw into top of piston. A small teflon seat ring at bottom of piston must be removed.

t. Remove the complete high pressure switch assembly (HP-1 and HP-2) (See Figure 6-21) and install on new compressor after checking switch settings. Remove compressor discharge temperature sensor (CDT) and install on new compressor.

u. Swap the brackets from the old compressor to the new one as needed. Use new locknuts.

v. Install compressor in unit by reversing steps 6.18.c through n. (See Figure 6-35 for torque values.) Install new gaskets on service valves and tighten bolts uniformly. Refer to Figure 6-20 and Section 6.35.1 drive gear installation.

w. Attach manifold gauges (with hand valves near vacuum pump) to the suction and discharge service valves. Dehydrate and evacuate compressor to 500 microns (29.90" Hg vacuum = 75.9 cm Hg vacuum). Turn off valves on manifold gauges.

x. Reconnect battery cable.

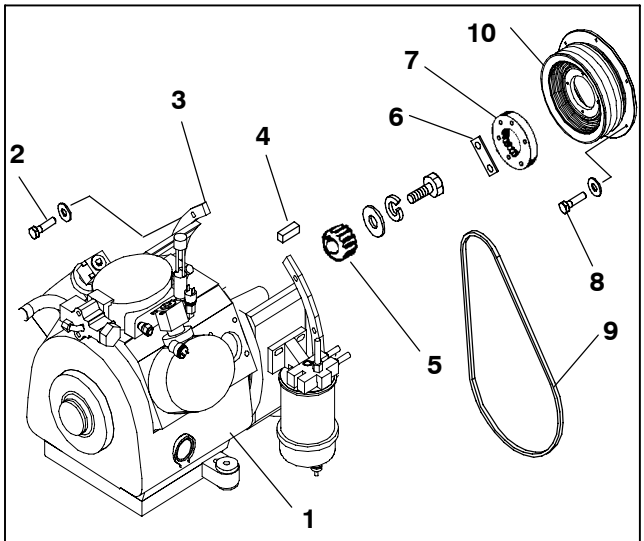
y. Start unit and check for noncondensibles. (Refer to Section 6.25.1).

z. Check refrigerant level (Refer to Section 6.17)

aa. Check compressor oil level. (Refer to Section 6.19) Add oil if necessary.

ab. Check compressor unloader operation. (Refer to Section 6.20)

ac. Check refrigerant cycles. (Refer to Section 2)



1. Compressor
2. Bolts
3. Spacer
4. Key
5. Compressor Drive Gear
6. Locking Tab
7. Nylon Drive Gear
8. Drive Sheave Bolts
9. V-Belt
10. Engine Adapter Drive Sheave

Figure 6-20. Compressor Drive Assembly

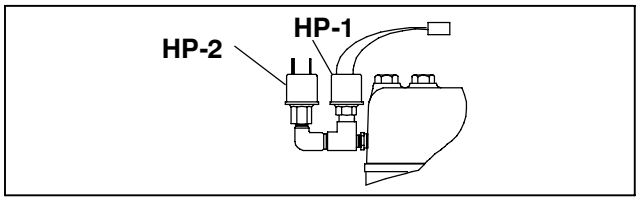


Figure 6-21. Pressure Switches HP-1 and HP-2

6.19 CHECKING COMPRESSOR OIL LEVEL

6.19.1 To Check the Oil Level in the Compressor:

a. Operate the unit in high speed, fully loaded cool for at least 15 minutes. Unplug wires to the unloaders if necessary to ensure 6 cylinder operation.

NOTE

Check the oil sight glass on the compressor to ensure that no foaming of the oil is present after 15 minutes of operation. If the oil is foaming check the refrigerant system for flood-back of liquid refrigerant. Correct this situation before performing step 2.

b. After 15 minutes, initiate a defrost cycle. This will allow any residual oil in the system to be returned to the compressor.

NOTE

Operate the unit in defrost for 3–5 minutes only. **Do not allow the unit to terminate defrost automatically.** The sudden reduction of crankcase pressure at defrost termination could cause a temporary increase in oil circulation and give a false oil level reading.

c. After 3 to 5 minutes of defrost operation, turn the unit off and wait 5 to 15 seconds. Observe the compressor oil level in the sightglass. (See Figure 6-22). Oil level should be between the Minimum and Maximum marks.

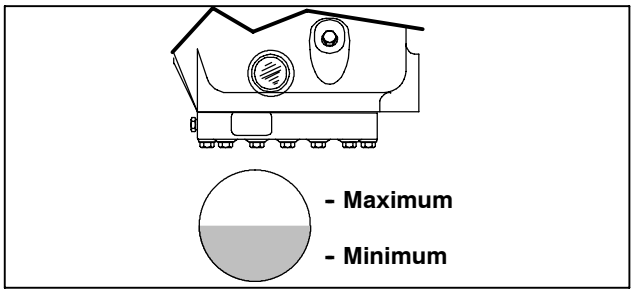


Figure 6-22. Oil Level in Sight Glass

6.19.2 Adding Oil with Compressor in System

A manual oil pump that may be purchased is a Robinair, part no. 14388. This oil pump adapts to a one U.S. gallon (3.785 liters) metal refrigeration oil container and pumps 2-1/2 ounces (0.0725 liters) per stroke when connected to the oil fill (item 3. Figure 6-23). An oil hose must be adapted to fit the fill port.

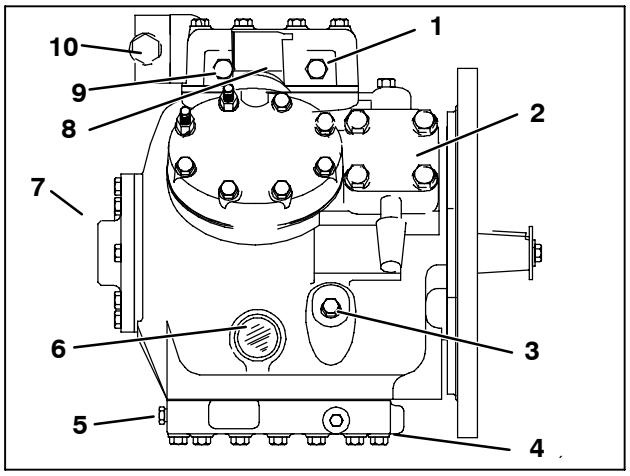
Start unit, frontseat suction service valve and pump compressor down (See section 6.13.11) to approx 1 to 2 psig (0.07 to 0.14 Bar). Place the Run/Stop switch in the STOP position. Frontseat discharge service valve and recover remaining refrigerant from compressor.

⚠ WARNING

Never run unit with discharge service valve frontseated.

Never remove fill plug with pressure in compressor.

Remove oil fill plug, (item 3. Figure 6-23), purge the oil pump hose with clean fresh oil. Connect oil hose to oil fill port. Add oil as required to raise level in sight glass as needed (Refer to Section 2.11). Re-install fill plug and evacuate compressor. Backseat suction and discharge service valves. Start unit and check oil level.



1. High Pressure Switch Connection
2. Suction Service Valve
3. Oil Fill Plug
4. Bottom Plate
5. Oil Drain Plug
6. Oil Level Sight Glass
7. Oil Pump
8. Unloader Solenoid
9. Discharge Temperature Sensor Connection
10. Discharge Service Valve

Figure 6-23. Compressor

6.19.3 Adding Oil to Service Replacement Compressor

Service replacement compressors may or may not be shipped with oil.

If compressor is without oil:

Add correct oil charge (Refer to Section 2.11) through the suction service valve flange cavity or by removing the oil fill plug (See Figure 6-23)

6.19.4 To remove oil from the compressor:

a. Close suction service valve (frontseat) and pump unit down to 1 to 2 psig (0.07 to 0.1 Bar). Shut off unit and front seat discharge service valve. Slowly bleed remaining refrigerant.

b. Slowly remove the oil drain plug (item 5. Figure 6-23) from the compressor and drain the proper amount of oil. Replace the plug securely back into the compressor.

c. Open service valves and run unit to check oil level, repeat as required to ensure proper oil level.

6.20 COMPRESSOR UNLOADER VALVE

The compressor unloaders (located on the compressor cylinder heads) are controlled by relays UFR and URR and the temperature controller. (Refer to Section 4.5.1)

6.20.1 Checkout Procedure

a. Connect manifold gauges to the compressor suction and discharge service valves and start unit in cooling with the set point within 1 to 2°F (0.6 to 1.1°C) of the refrigerated compartment temperature.

b. Unplug both unloader coils. The compressor should be operating with all 6 cylinders. Note suction pressure.

c. Use jumper wires connected to the unit battery to energize the UF (front unloader). Note discharge and suction pressures, the suction pressure should rise approximately 3 psig (0.2 Bar), and the discharge should drop approximately 5 to 15 psig (0.35 to 1.05 Bar).

d. Disconnect UF from the jumper wires so that it is de-energized and note pressures. Suction pressure should drop and discharge pressure should rise by the same amounts they changed in step 3 above.

e. Repeat steps c. & d. for UR (rear unloader). At the end of the test, remove jumper wires and plug both unloaders back in to unit harness.

NOTE

If either unloader coil energizes and the suction pressure does not change, the unloader assembly must be checked.

6.20.2 Unloader Coil Replacement

NOTE

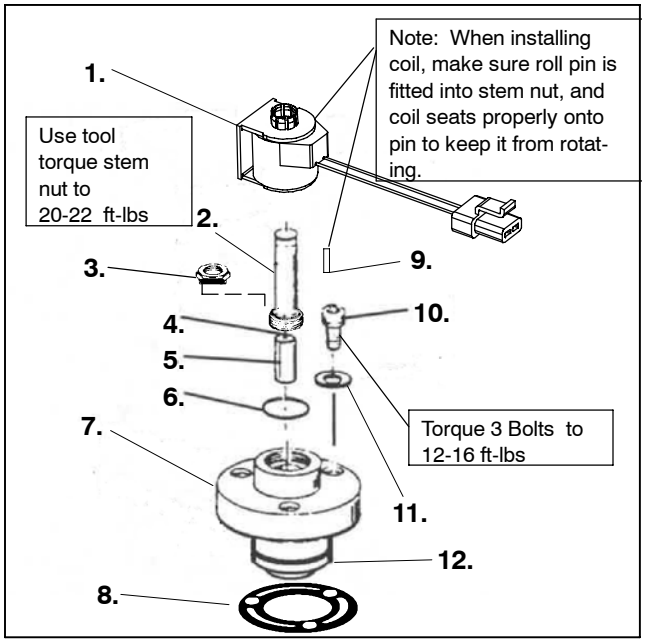
The coil may be removed without pumping the unit down.

a. Disconnect leads. Remove retainer, if equipped. Lift coil from stem. (See Figure 6-24)

b. Check unloader coil resistance with an ohm meter. Correct resistance should be between 7.5 and 10.5 ohms.

c. Verify coil type, voltage and frequency of old and new coil. This information appears on the coil housing.

d. Place new coil over enclosing tube and retainer and connect wiring.



1. Coil Assembly
2. Stem/Enclosing Tube Assy
3. Installation/Removal Tool
4. Spring, Plunger
5. Plunger Assembly
6. "O" Ring
7. Valve Body
8. Gasket, Valve Body
9. Pin, Anti-Rotation (fits into top of stem nut)
10. Bolts, Valve Body (3)
11. Washers (3)
12. Piston (use only with hot gas bypass unloaders)

Figure 6-24. Unloader Solenoid Valve

6.20.3 Replacing Solenoid Valve Internal Parts (See Figure 6-24)

a. Pump down the unit. (Refer to Section 6.14) Frontseat both service valves to isolate the compressor.

b. Remove coil retaining cap (if equipped), and coil.

c. Remove enclosing tube assembly (item 2., Figure 6-24) using installation/removal tool supplied with repair kit (item 3).

d. Check plunger for restriction due to: (a) Corroded or worn parts; (b) Foreign material lodged in valve; (c) Bent or dented enclosing tube.

e. Install new parts. Do not over–tighten enclosing tube assembly. Torque to a value of 20 to 22 ft– lbs (27 to 30 Nm).

f. Remove supplied installation/removal tool. Install coil and retaining cap (if equipped).

g. Evacuate and dehydrate the compressor. (Refer to Section 6.18.p through 6.18.w.)

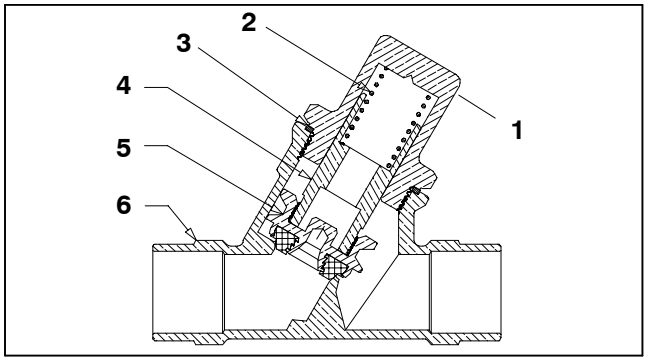
h. Start unit and check unloader operation (Refer to Section 6.20.a).

6.21 REPLACING OR SERVICING CHECK VALVE

A check valve allows the hot gas to travel in one direction only.

The function of the Hot Gas Bypass Check Valve is to raise the receiver pressure when the ambient temperature is low so that refrigerant can flow from the receiver to the evaporator when the unit is in heating or defrost.

The function of the Discharge Line Check Valve is to prevent any liquid refrigerant from migrating into the compressor during the unit off cycle.



1. Cap
2. Spring
3. Gasket
4. Stem
5. Seat
6. Body

Figure 6-25. Discharge Check Valve (Serviceable) Prior to S/N JAW90756460

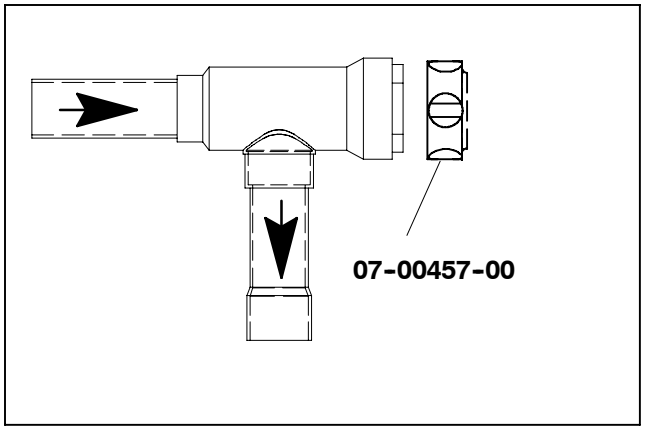


Figure 6-26. Discharge Check Valve (Non-Serviceable) Beginning With S/N JAW90756460

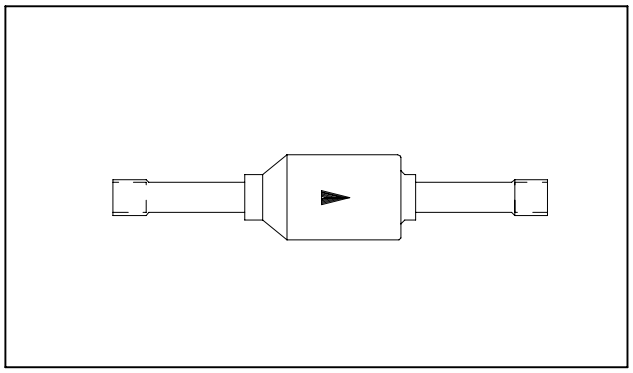


Figure 6-27. Hot Gas Check Valve (Non-Serviceable)

6.21.1 To Service Check Valve (See Figure 6-25)

a. Store the refrigerant in an evacuated container. (Refer to Section 6.14)

b. Replace necessary parts.

c. Evacuate and dehydrate unit. (Refer to Section 6.16)

d. Add refrigerant charge. (Refer to Section 6.17)

6.21.2 To Replace Check Valve (See Figure 6-26 and Figure 6-27)

NOTE

These check valves are not serviceable and must be removed and replaced as an assembly.

a. Store the refrigerant in an evacuated container. (Refer to Section 6.14)

b. Using a pipe cutter, cut the valve stub-outs on valve and unsweat the remaining stub-out from the connecting copper in the unit.

NOTE

Inert brazing techniques MUST be followed during replacement of valves.

NOTE

Place magnetic discharge check valve tool (07-00457-00) on top of discharge check valve (Figure 6-26) to pull the plunger from the body seat.

c. Replace valve.

d. Evacuate and dehydrate unit. (Refer to Section 6.16)

e. Add refrigerant charge. (Refer to Section 6.17)

6.22 CHECKING AND REPLACING FILTER-DRIER

6.22.1 To Check Filter-Drier

Check for a restricted or plugged filter-drier by feeling the liquid line inlet and outlet connections of the drier cartridge. If the outlet side feels cooler than the inlet side, then the filter-drier should be changed.

6.22.2 To Replace Filter-Drier:

a. Pump down the unit per Section 6.14. Remove bracket, then remove drier.

b. Install and lubricate o–rings on drier.

c. Position drier so that arrow points in downward direction.

d. Tighten fitting on drier.

e. Secure clamp.

f. Check drier connections for leaks.

g. Check refrigerant level.

6.23 THERMOSTATIC EXPANSION VALVE

The thermostatic expansion valve (TXV) is an automatic device which maintains constant superheat of the refrigerant gas leaving the evaporator regardless of suction pressure. The valve functions are: (a) automatic response of refrigerant flow to match the evaporator load and (b) prevention of liquid refrigerant entering the compressor. Unless the valve is defective, it seldom requires any maintenance.

6.23.1 Replacing Expansion Valve & Screen

a. Pump down the unit by closing the king valve. (Refer to Section 6.14)

b. Remove insulation (Presstite) from expansion valve bulb and then remove bulb from suction line.

c. Remove Presstite from the expansion valve power head.

d. Cut TXV from system tubing close to TXV body.

NOTE

Use a wet rag to prevent system tubing from overheating whenever brazing.

e. Unsolder TXV stubs from piping.

f. Inspect strainer for debris. Clean if possible. Replace if strainer is torn. Install new strainer, with cone of screen pointing into liquid line at inlet to the valve.

g. Position new valve.

h. Wrap valve with wet rags to keep TXV cool whenever brazing and clean all tube stubs in system tubing so new valve fits easily.

i. Solder valve in place and cool connections with wet rag.

j. Pressure test braze joints for leaks.

k. The thermal bulb is located at 5 or 7 o'clock position on the suction line (See Figure 6-28). This area must be clean to ensure positive bulb contact. Apply thermal mastic and strap thermal bulb to suction line and insulate both with presstite.

l. Wrap TXV power head with presstite.

m. Evacuate by placing vacuum pump on suction service valve.

n. Open king valve and then check refrigerant level. (Refer to Section 6.17)

6.23.2 Checking Superheat

NOTE

Superheat cannot be adjusted on the braze–in TXV. I superheat is out of adjustment, the valve must be replaced.

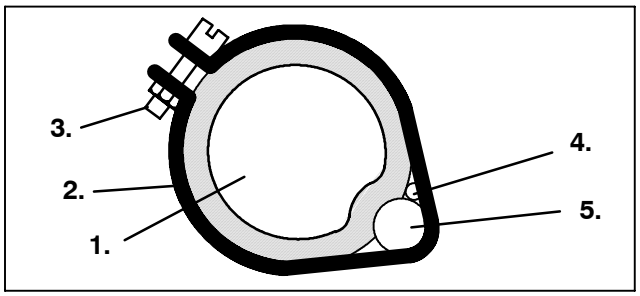
6.23.3 To Measure Superheat

NOTE

The expansion valve and bulb location are shown in Figure 2-7.

a. Remove evaporator panel from rear of unit and then remove Presstite from expansion valve bulb and suction line.

b. Loosen one TXV bulb clamp and make sure area under clamp (above TXV bulb) is clean.



1. Suction Line
2. TXV Bulb Clamp
3. Nut and Bolt (Clamp)
4. Thermocouple
5. TXV Bulb

Figure 6-28. Thermostatic Expansion Valve Bulb and Thermocouple

NOTE

When conducting this test the suction pressure must be at least 6 psig (0.4 Bar) below expansion valve maximum operating pressure (MOP). (Refer to Section 2.12)

c. Place thermocouple above (parallel with) the TXV bulb and then secure loosened clamp making sure both bulbs are firmly secured to suction line as shown in Figure 6-28.

d. Connect an accurate gauge to the 1/4" port on the suction service valve.

e. Run unit until stabilized. Set controller 10°F (5.5°C) below box temperature.

f. From the temperature/pressure chart (Refer to Table 6-3), determine the saturation temperature corresponding to the evaporator outlet pressure.

g. Note the temperature of the suction gas at the expansion valve bulb.

h. Subtract the saturation temperature determined in Step f. from the average temperature measured in Step g. The difference is the superheat of the suction gas.

6.24 CHECKING AND REPLACING HIGH PRESSURE CUTOUT SWITCHES

6.24.1 Replacing High Pressure Switch

a. Pump down the refrigeration system and shut unit off. (Refer to Section 6.13.11)

⚠ WARNING

Never run unit with discharge service valve frontseated.

b. Frontseat the discharge service valve in order to isolate the compressor.

c. *Slowly* release compressor pressure through the service valve gauge ports.

d. Disconnect wiring from defective switch. The high pressure switches are located on the top cylinder head. (See Figure 6-23)

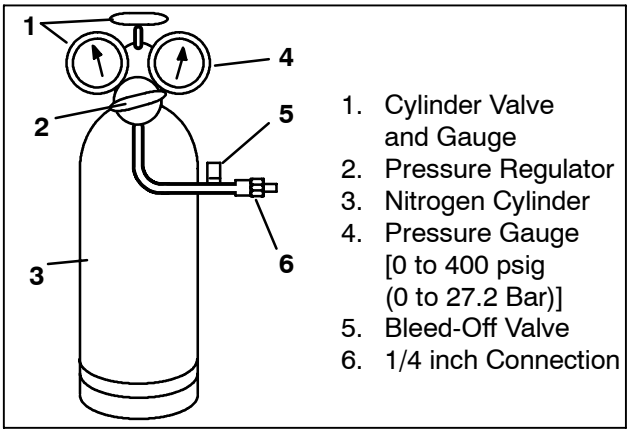
e. Install new cutout switch after verifying switch settings. (Refer to Section 6.24.2)

f. Evacuate and dehydrate the compressor. (Refer to Section 6.18.p through 6.18.w**)**

6.24.2 Checking High Pressure Switch (HP-1 or HP-2)

⚠ WARNING

Do not use a nitrogen cylinder without a pressure regulator. Cylinder pressure is approximately 2350 psig (159.9 Bar). Do not use oxygen in or near a refrigerant system as an explosion may occur. (See Figure 6-29)



1. Cylinder Valve and Gauge
2. Pressure Regulator
3. Nitrogen Cylinder
4. Pressure Gauge [0 to 400 psig (0 to 27.2 Bar)]
5. Bleed-Off Valve
6. 1/4 inch Connection

Figure 6-29. Typical Setup for Testing High Pressure Switch

a. Remove switch as outlined in Section 6.24.1.

b. Connect ohmmeter or continuity light across switch terminals. Ohmmeter will indicate resistance and continuity light will be lighted if switch closes after relieving pressure.

c. Connect switch to a cylinder of dry nitrogen. (See Figure 6-29)

d. Set nitrogen pressure regulator higher than cutout point on switch being tested. Pressure switch cutout and cut-in points are shown in Section 2.12.

e. Close valve on cylinder and open bleed-off valve.

f. Open cylinder valve. Slowly close bleed-off valve and increase pressure until the switch opens. If light is used, light will go out. If an ohmmeter is used, the meter will indicate open. Open pressure on gauge. Slowly open bleed-off valve (to decrease pressure) until switch closes (light will light or ohmmeter will move).

6.25 REPLACING RECEIVER SIGHT GLASS ASSEMBLY AND FUSIBLE PLUG

a. Remove refrigerant from unit and store the refrigerant in an evacuated container. (Refer to Section 6.14)

b. Unscrew the sight glass assembly. Wrap threads with Teflon tape or spread some sealing compound on pipe threads of new sight glass assembly or plug and install. The torque value for either the sight glass assembly or the plug is 20-25 ft-lbs (27 to 34 Nm)

c. Leak check receiver sight glass or fusible plug per Section 6.15.

d. After leak checking unit, evacuate and dehydrate as outlined in section 6.16.

e. Add refrigerant charge. (Refer to Section 6.17)

f. Check for noncondensibles. (Refer to Section 6.25.1).

6.25.1Checking For Noncondensibles

To check for noncondensibles, proceed as follows:

1 Stabilize system to equalize pressure between the suction and discharge side of the system. The engine needs to be off for several hours.

2 Measure temperature at any of the copper tubing in the condenser.

3 Check pressure at the compressor discharge service valve.

4 Determine saturation pressure as it corresponds to the condenser temperature using the Temperature-Pressure Chart, Table 6-3.

5 If gauge reading is 3 psig (0.2 BAR) or higher than the calculated P/T pressure in step 4, noncondensibles are present.

6 Remove refrigerant using a refrigerant recovery system. (Refer to Section 6.14)

7 Evacuate and dehydrate the system. (Refer to Section 6.16)

8 Charge the unit. (Refer to Section 6.17)

6.26 SERVICING SOLENOID VALVES

6.26.1 SV-2/SV-4

⚠ CAUTION

Do not over tighten or damage the enclosing tube assembly. Torque to 17-ft pounds (23 Nm). Also make sure all parts are placed on the enclosing tube in proper sequence to avoid premature coil burnout.

a. Replacing the Coil

NOTE

Coils may be replaced without removing the refrigerant or pumping the unit down.

1. Unplug from wiring harness, remove coil retainer and coil assembly.
2. Verify coil type, voltage and frequency. This information appears on the coil housing.
3. Place new coil over enclosing tube and retainer and connect wiring.

b.Replacing Solenoid Valve Internal Parts (See Figure 6-31)

To service the liquid line solenoid valve (SV-2) or the hot gas solenoid valve (SV-4) first pump the unit down. (Refer to Section 6.14)

Remove and store the refrigerant charge in an evacuated container. (Refer to Section 6.14)

1. Remove coil retainer and coil assembly from valve. Remove enclosing tube assembly and related items.
2. Check for foreign material in valve body.
3. Install new parts.

NOTE

Rebuild kit (P/N 14-00150-51) contains both a black neoprene seal and a white teflon seal. Use the one that matches seal in existing valve. The valve with the teflon seal can be identified by two dimples in the housing. (See Figure 6-30)

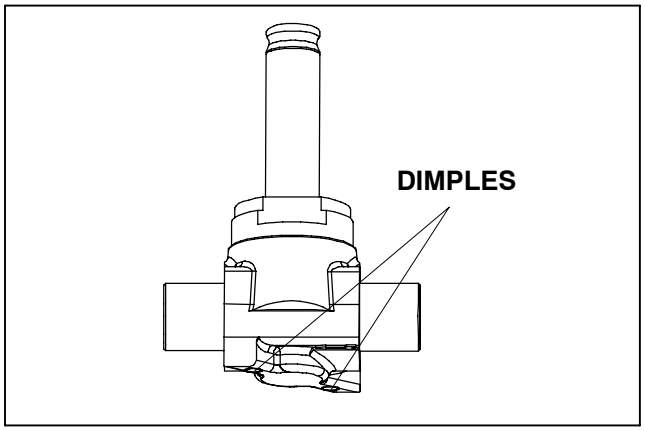
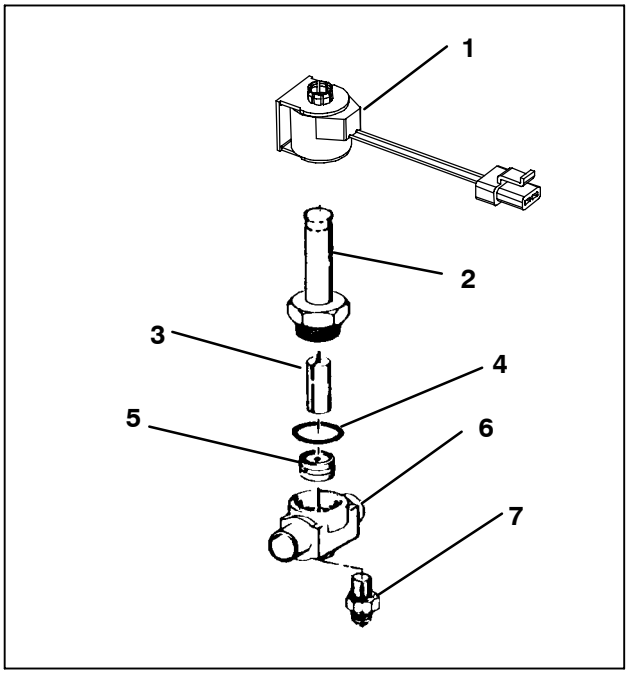


Figure 6-30. SV-2/SV-4 MARKING

4. Tighten enclosing tube assembly according to the following chart and leak check the valve (Refer to Section 6.15)

SEAL DESCRIPTION	TORQUE VALUE
TEFLON (WHITE)	250 in-lbs (28 Nm)
NEOPRENE (BLACK)	100 in-lbs (11 Nm)

5. Install coil assembly and retainer.
6. Start unit and check refrigerant charge per Section 6.17.f.
7. Check refrigeration cycles.



1. Coil Assembly
2. Enclosing Tube Assy
3. Plunger Assy
4. Seal
6. Piston Assy
7. Body
8. Bracket Adapter

Figure 6-31. SV-2 and SV-4

6.26.2 Solenoid Valve – SV1

a. Replacing the Coil

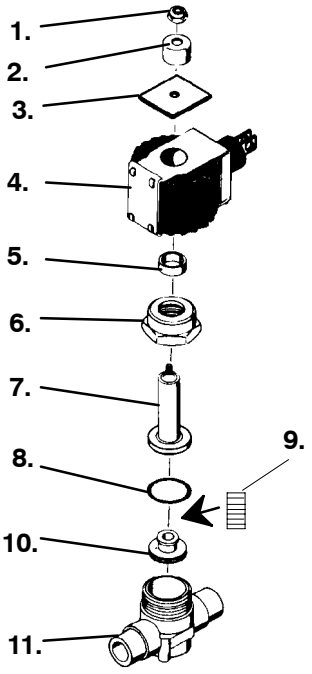
NOTE

The coil may be replaced without removing the refrigerant or pumping the unit down.

1. Remove top locknut, spacer cup and nameplate (SV1).
2. Disconnect wiring and remove coil.
3. Replace coil by reversing steps 1 and 2.

b. Replacing Internal Components (See Figure 6-32)

1. Remove and store the refrigerant charge in an evacuated container. (Refer to Section 6.14)
2. Remove the top locknut, spacer cup, nameplate, coil assembly and spacer (SV1).
3. Using a 12 point, 1-3/8 inch box wrench, loosen the enclosing tube locknut and bleed off remaining refrigerant.
4. Remove enclosing tube and locknut assembly. The gasket is inside the enclosing tube.
5. Remove seat disc from inside of body, check for obstructions, foreign material and wear inside valve body.
6. Place the seat disc into the valve body with the smaller diameter end facing up.
7. Place the enclosing tube locknut over the enclosing tube. Install spacer over enclosing tube making sure it is seated properly in the enclosing tube locknut. Tighten enclosing tube locknut to a torque value of 250 inch-lb (28 Nm). Do not over-tighten.
8. Install coil assembly, nameplate and top locknut or screw.
9. Dehydrate and evacuate the system. (Refer to Section 6.16) Charge unit with refrigerant per Sections 6.17.
10. Start unit and check operation. (Refer to Section 2)



SV-1

1. Locknut/Screw
2. Spacer Cup
3. Nameplate
4. Coil
5. Spacer
6. Enclosing Tube Locknut
7. Enclosing Tube
8. Gasket
9. Closing Spring
10. Seat Disc
11. Body

Figure 6-32. SV-1

c. Solenoid Valve SV1 Checkout Procedure

To obtain proper heating and defrost, the normally open (N.O.) SV-1 solenoid valve must energize and close tightly during the heat and defrost cycles. If the valve does not close tightly due to physical damage, foreign material or wear, refrigerant leakage through the valve can reduce heating capacity.

During normal heat or defrost cycles the following conditions will be observed when the valve is operating properly:

1. Receiver refrigerant level will drop quickly at the initiation of heating or defrost mode.
2. Suction pressure will rise slowly to 90-100 PSIG (6.12 to 6.80 Bar).
3. Discharge pressure will drop quickly, but begin to rise to a minimum of 250 psig (17.0 Bar) within 15 to 20 minutes.

If suction and discharge pressures remain low and the receiver level does not drop, the valve may be inoperative and can be checked by the following method:

1. With the unit off, disconnect the oil pressure safety switch and place a jumper across the plug terminals.
2. Remove the wires from SV-4, Front Unloader, and the HP-2 switch.
3. Re-adjust setpoint to 20°F to 25°F (11.1° to 13.9°C) above box temperature so that the unit will be able to start. (It may be necessary to run unit in Cool prior to this step).
4. Start the unit. Allow the unit to run 30 – 45 seconds. The suction pressure should fall to approximately 0 psig and the receiver pressure near or below 200 psig. Closely monitor both high pressure gauges while connecting the wire to the HP-2 switch. Compressor discharge pressure will begin to rise. Receiver pressure should not rise. When the compressor discharge pressure reaches 390 psig, shut the engine off using the stop lever on the injection pump. (The microprocessor will remain energized). The compressor discharge pressure will drop off, but the receiver pressure should not change. Any rise in receiver pressure indicates internal leakage at the SV-1 valve. See Section 6.26.2 for instructions on repair and replacement.
5. Observe the suction gauge. Using a jumper wire, momentarily energize SV-4. The valve should open and the suction pressure begin to rise. Remove the jumper and observe. The valve should close and the suction pressure should stop rising. Energize the valve 2 to 3 times to verify consistent valve operation.
6. Place the Run/Stop switch in the STOP position. Reconnect the wires to SV-4, Front Unloader, and the the oil safety switch.

6.27 CHECKING DEFROST OR HEATING

6.27.1 Defrost Operation

a. Turn the unit on and re-adjust the setpoint to 0°F (–17.8°C). Run the unit in High Speed Cool and allow the box temperature to drop below 35°F (1.7°C).

b. Place the unit into defrost manually.

c. Make sure the unit goes into defrost properly and that the engine is running in High Speed.

NOTE

If the ambient temperature sensor is above 80°F (26.7°C), the high ambient defrost cycle may be initiated. Refer to Section 4.2.2.

d. Check that the fan clutch has disengaged and that the fan shaft is not turning.

e. The unit should come out of defrost automatically.

NOTE

The box temperature must be 40°F (4.4°C) or lower, before any checks can be made.

6.27.2 Hot Gas Solenoid Valve (SV-1 & SV-4) Heating and Defrosting

a. Connect a discharge pressure gauge to the king valve and another gauge to the compressor discharge service valve. Connect a gauge to the compressor suction service valve.

b. Start unit with controller set at least 10°F (5.5°C) below indicated box temperature to obtain high speed cooling. Press the MANUAL DEFROST key to initiate defrost. [Box temperature must be below 40°F (4.4°C).] The hot gas solenoid valve (SV4) will energize and the hot gas line will be hot to touch on both sides of the valve. The condenser pressure control solenoid (SV1) closes and suction pressure will rise approx 10 to 15 psig (0.68 to 1.02 Bar) after 5 minutes of unit operation. Refer to Section 4.2 if unit does not heat properly.

c. Unit should remain in defrost until evaporator coil temperature reaches 55°F (12.8°C). At this point the defrost cycle will terminate and the unit will resume automatic operation.

6.27.3 Defrost Air Switch (DA)

NOTE

Box temperature must be l40°F (4.4°C) or lower to initiate defrost.

a. To check the defrost air switch, run unit in high speed cooling and place a jumper wire across the air switch terminals. This will start the defrost cycle as it simulates the action of the defrost air switch. Bypassing the switch in this manner operates all components involved in defrost.

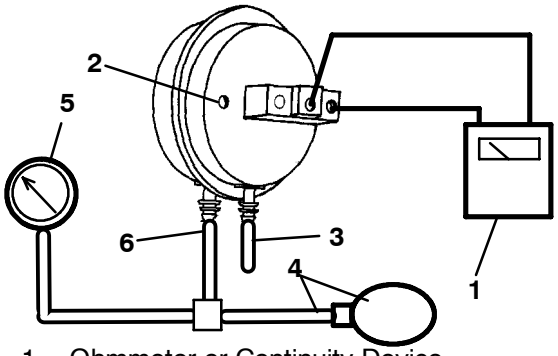
b. Unit should remain in defrost until evaporator coil temperature reaches approx 50°F (10°C). At this point the defrost thermostat(s) should open to terminate the defrost cycle and the unit will resume automatic operation. Check the defrost thermostat(s) if unit fails to terminate defrost. (See Section 1.5)

c. If the above test indicates satisfactory operation, test defrost air switch (DA) settings using a Dwyer Magnehelic gauge (P/N 07-00177) or similar instrument. (Refer to Section 6.28)

6.27.4 Solid State Defrost Timer

Refer to Section 4.2.2 for description.

6.28 CHECKING CALIBRATION OF THE DEFROST AIR SWITCH



1. Ohmmeter or Continuity Device
2. Adjustment Screw (0.050 socket head size)
3. Low Side Connection
4. Pressure Line or Aspirator Bulb (P/N 07-00177-01)
5. Magnehelic Gauge (P/N 07-00177)
6. High Side Connection

Figure 6-33. Defrost Air Switch Test Setup

a. Make sure magnehelic gauge is in proper calibration.

NOTE

The magnehelic gauge may be used in any position, but must be re-zeroed if position of gauge is changed from vertical to horizontal or vice versa. USE ONLY IN POSITION FOR WHICH IT IS CALIBRATED. The Defrost Air switch MUST be in the same orientation as it will be in when installed in the unit.

b. With air switch in vertical position, connect high pressure side of magnehelic gauge to high side connection of air switch. (See Figure 6-33)

c. Install tee in pressure line to high side connection. Tee should be approximately half-way between gauge and air switch or an improper reading may result.

d. Attach an ohmmeter to the air switch electrical contacts to check switch action.

NOTE

Use a hand aspirator (P/N 07-00177-01), since blowing into tube by mouth may cause an incorrect reading.

e. With the gauge reading at zero, apply air pressure very slowly to the air switch. An ohmmeter will indicate continuity when switch actuates. The switch contacts should close and the ohmmeter needle should move rapidly to 0. Any hesitation in the ohmmeter indicates a possible problem with the switch, and it should be replaced.

f. Refer to Section 2.12 for switch settings. If switch fails to actuate at correct gauge reading, adjust switch by turning adjusting screw clockwise to increase setting or counterclockwise to decrease setting.

g. Repeat checkout procedure until switch actuates at correct gauge reading.

h. After switch is adjusted, place a small amount of paint or glycerol on the adjusting screw so that vibration will not change switch setting.

6.29 EVAPORATOR COIL CLEANING

⚠ WARNING

Personal protection equipment must be utilized when performing coil cleaning.

The use of recycled cardboard cartons is increasing across the country. The recycled cardboard cartons create much more fiber dust during transport than “new” cartons. The fiber dust and particles are drawn into the evaporator where they lodge between the evaporator fins. If the coil is not cleaned on a regular basis, sometimes as often as after each trip, the accumulation can be great enough to restrict air flow, cause coil icing, repetitive defrosts and loss of unit capacity. Due to the “washing” action of normal defrost the fiber dust and particles may not be visible on the face of the coil but may accumulate deep within.

Clean the evaporator coil on a regular basis, not only to remove cardboard dust, but to remove any grease or oil film which sometimes coats the fins and prevents water from draining into the drain pan.

Cardboard fiber particles after being wetted and dried several times can be very hard to remove. Therefore, several washings may be necessary.

a. Remove rubber check valves (Kazoo) from drain lines (front of refrigerated compartment).

b. Remove evaporator bulkhead and back panel, then spray coil with a mild detergent solution such as Oakite 164 or any good commercial grade automatic dish washer detergent such as Electrosol or Cascade and let the solution stand for a few minutes and reverse flush (opposite normal air flow) with clean water at mild pressure. A garden hose with spray nozzle is usually sufficient. Make sure drain lines are clean.

c. Replace evaporator back panel and run unit until defrost mode can be initiated to check for proper draining from drain pan. (Refer to Section 2)

6.30 CONDENSER COIL CLEANING

⚠ WARNING

Personal protection equipment must be utilized when performing coil cleaning.

Remove all foreign material from the condenser coil by reversing the normal air flow. (Air is pulled in through the front and discharges over the engine.) Use an FDA approved cleaning agent whenever possible. Compressed air or water may be used as a cleaning agent. It may be necessary to use warm water mixed with any good commercial dishwasher detergent. Rinse coil with fresh water if a detergent is used.

6.31 MICROPROCESSOR CONTROLLER

NOTE

The erasable, programmable, read only memory (EEPROM) chip (component U3 on the microprocessor logic board) has a label on it listing the revision level of the software.

⚠ CAUTION

Under no circumstances should a technician electrically probe the processor at any point, other than the connector terminals where the harness attaches. Microprocessor components operate at different voltage levels and at extremely low current levels. Improper use of voltmeters, jumper wires, continuity testers, etc. could permanently damage the processor.

⚠ CAUTION

Most electronic components are susceptible to damage caused by electrical static discharge (ESD). In certain cases, the human body can have enough static electricity to cause resultant damage to the components by touch. This is especially true of the integrated circuits found on the truck/trailer microprocessor.

As mentioned above, some microprocessor inputs operate at voltage levels other than the conventional 12 VDC. Connector points and the associated approximate voltage levels are listed below for reference only. Under no circumstances should 12 VDC be applied at these connection points.

Grounded wrist cuffs are available from Carrier (P/N 07-00304-00). These should be worn whenever handling a microprocessor.

Table 6-2. Connection Point Voltage

Connection Point	Approximate Voltage
ATS, CDT, RAS, SAS, WTS	2.5 VDC (Variable)
MP23	5.0 VDC

Although there is less danger of electrical static discharge (ESD) damage in the outdoor environment – where the processor is likely to be handled – proper board handling techniques should always be stressed. Boards should always be handled by their edges, in much the same way one would handle a photograph. This not only precludes the possibility of ESD damage, but also lowers the possibility of physical damage to the electronic components. Although the microprocessor boards are fairly rugged when assembled, they are more fragile when separated and should always be handled carefully.

When welding is required on the unit frame, or on the front area of the trailer, ALL wiring to the microprocessor MUST be disconnected. When welding is performed on other areas of the trailer, the welder ground connection MUST be in close proximity to the area being welded. It is also a good practice to remove both battery cables before welding on either the unit frame or the trailer to prevent possible damage to other components such as the alternator and voltage regulator.

6.31.1 Replacing Keypad, Window or Door

Should damage to the keypad of the microprocessor occur, it is possible to replace only the keypad.

All replacement keypads are packaged with replacement gaskets.

Keypad Removal – Short Box

a. Place the Start/Run–Off switch (SROS) in the "OFF" position and disconnect the negative battery cable. Attach a grounded wrist strap (CTD P/N 07–00304–00) and ground it to a good unit frame ground.

b. Open the roadside side door of the unit and loosen the (4) hex/slotted head 1/4–20 bolts that hold the control box cover/bezel assembly onto the front of the control box. Remove the cover and hang it by its tethers below the control box.

c. Remove the wires connected to the SROS. Unplug the 14–pin and 60–pin ribbon cables from the display and micro logic boards.

d. Loosen the (5) 8–32 hex head bots that secure the micro logic board. Make sure the cover is secured before removing the screws because the front (2) hex head bolts hold the cover and display assembly tethers.

e. Remove the front (2 hex head bolts, unhook the tethers from the standoffs and place the display assembly aside.

f. Remove the (4) 5mm x 20mm lg. hex head bolts that secure the bezel assembly to the control box.

g. Unplug the 10–pin ribbon cable that attaches the keypad board to the display board. Remove the (4) Phillips head screws that attach the display board to the keypad board and place the display board aside.

h. Remove the (11) Phillips head screws that attach the keypad and window to the bezel. Gently remove the window and keypad from the bezel. Discard the old keypad.

NOTE

All gaskets must be replaced any time the keypad is removed from the bezel.

Keypad Installation – Short Box

⚠ CAUTION

Do not overtorque screws.

a. Remove both gaskets from the clear window. Ensure that the surface is completely free of old gasket material and install the new gaskets.

NOTE

The two window gaskets are different. The gasket for the window and bezel is notched for clearance around the detents.

b. Place the clear window and new keypad on the (3) alignment pins of the bezel.

c. Loosely install the (11) Phillips head screws, [(8) 3/4" lg and (3) 3/8" lg with a blunt tip] to the keypad board. Check alignment of window and keypad to endure proper sealing at bezel. Torque screws to 12 in.lbs. (1.3 Nm).

d. Hold the display board in place and connect the ribbon cable from the keypad and window assembly while you can still see the pins on the circuit board.

e. Place display board onto the (2) locating pins and secure display board with the (4) 3/8" lg Phillips head screws. Torque screws to 12 in.lbs. (1.3 Nm).

f. Remove old gasket from door mounting bracket.

g. Ensure surface is completely free of old gasket material and install new gasket.

h. Plug wire harness into new display board and reconnect wires to SROS.

i. Secure the bezel to the control door with the (4) 5mm X 20mm lg. hex head bolts. Torque bolts to 26 in. lbs. (3 Nm).

j. Fasten bezel and bracket assembly to unit side door using (4) hex head 1/4–20 bolts.

k. Reconnect wiring harness (60–pin connector) from microprocessor.

l. Reconnect negative battery cable and check unit operation.

Keypad Removal – Tall Box

a. Place the (SROS) in the "OFF" position and disconnect the negative battery cable. Attach a grounded wrist strap (CTD P/N 07–00304–00) and ground it to a good unit frame ground.

b. Open the roadside side door of the unit and loosen the (2) hex/slotted head 1/4–20 bolts that hold the control box cover/bezel assembly onto the front of the control box. Lift the cover and use prop rod to hold cover up.

c. Remove the wires connected to the SROS. Unplug the 14–pin cable from the display board.

d. Loosen the (4) 5mm X 20mm hex head bolts that secure the display board to the control box cover.

e. Unplug the 10–pin ribbon cable that attaches the keypad board to the display board. Remove the (4) Phillips head screws that attach the display board to the keypad board and place the display board aside.

f. Remove the (11) Phillips head screws that attach the keypad and window to the bezel. Gently remove the window and keypad from the bezel. Discard the old keypad.

NOTE

All gaskets must be replaced any time the keypad is removed from the bezel.

Keypad Installation – Tall Box

⚠ CAUTION

Do not overtorque screws.

a. Remove both gaskets from the clear window. Ensure that the surface is completely free of old gasket material and install the new gaskets.

NOTE

The two window gaskets are different. The gasket for the window and bezel is notched for clearance around the detents.

b. Place the clear window and new keypad on the (3) alignment pins of the bezel.

c. Loosely install the (11) Phillips head screws, [(8) 3/4" lg and (3) 3/8" lg with a blunt tip] to the keypad board. Check alignment of window and keypad to endure proper sealing at bezel. Torque screws to 12 in.lbs. (1.3 Nm).

d. Hold the display board in place and connect the ribbon cable from the keypad and window assembly while you can still see the pins on the circuit board.

e. Place display board onto the (2) locating pins and secure display board with the (4) 3/8" lg Phillips head screws. Torque screws to 12 in.lbs. (1.3 Nm).

f. Remove old gasket from door mounting bracket.

g. Ensure surface is completely free of old gasket material and install new gasket.

h. Plug 10–pin wire harness into new display board and reconnect wires to SROS.

i. Secure the bezel to the control door with the (4) 5mm X 20mm lg. hex head bolts. Torque bolts to 26 in. lbs. (3 Nm).

j. Reconnect wiring harness (14–pin connector) from microprocessor.

k. Reconnect negative battery cable and check unit operation.

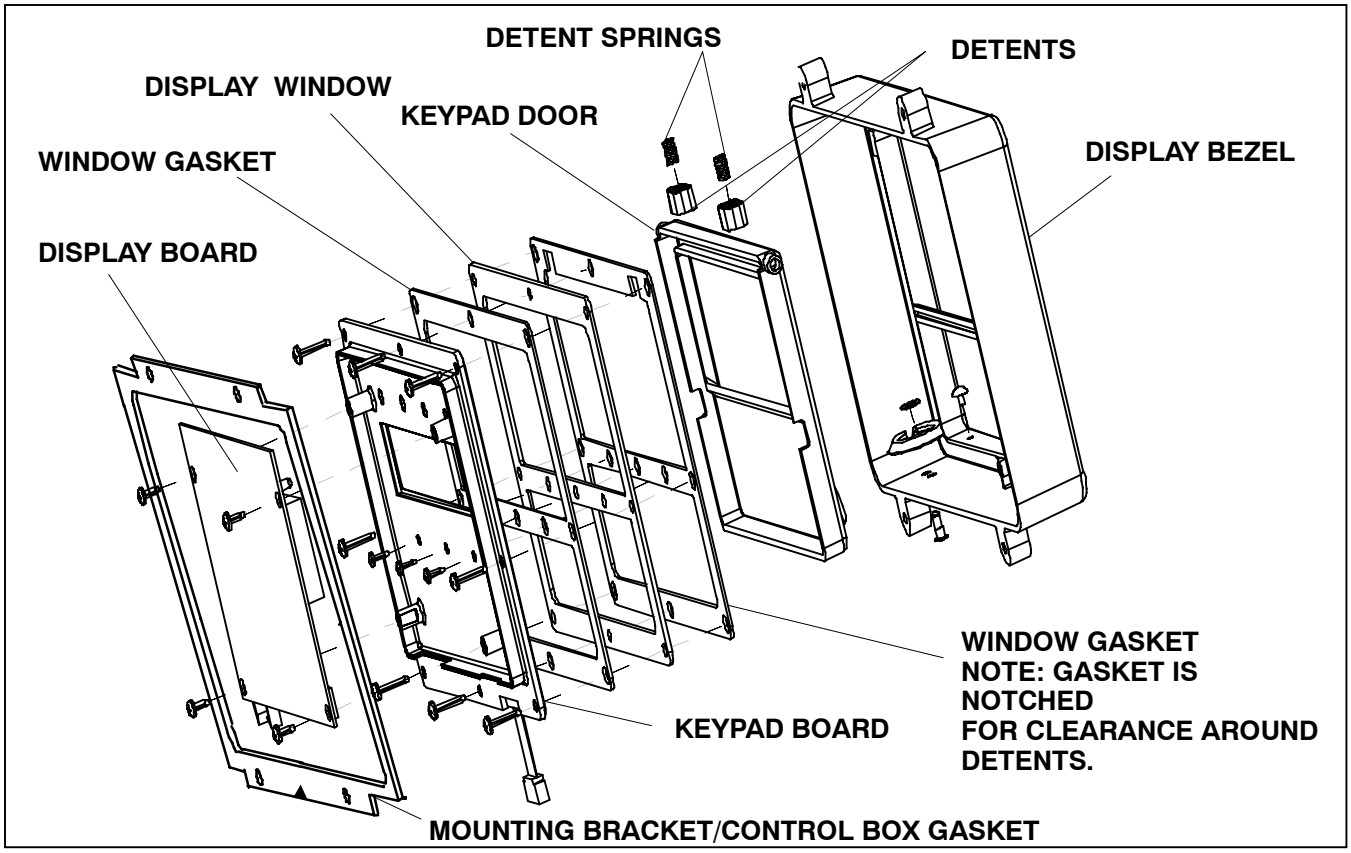


Figure 6-34. Display Module Assembly

6.32 MICROPROCESSOR REPLACEMENT and CONFIGURATION

6.32.1 To Remove and Replace Microprocessor Logic Board - Short Box:

⚠ CAUTION

Do not drill out the logic board standoffs to remove the plastic cover. Permanent damage to the microprocessor will result.

a. Before removing the microprocessor, turn the SROS to the "OFF" position and disconnect the negative battery cable. Attach a grounded wrist strap (CTD P/N 07-00304-00) to your wrist and ground it to a good unit frame ground.

b. Open the roadside side door of the unit and loosen the (4) bolts holding the cover / display assembly onto the front of the control box. Remove the cover and hang it below the control box by its tethers.

c. Remove the wires connected to the SROS. Unplug the (2) ribbon cables from the micro but leave them connected to the relay board and display.

NOTE

Microprocessors mounted on the floor of the control box will have a plastic cover over the board. Vertically mounted micros do not require a plastic cover. Install the correct micro for the unit.

d. Loosen the (5) hex head screws securing the logic board. The front (2) screws hold the cover & display assembly tethers, so make sure the cover is secured before removing screws.

e. Remove the front (2) screws and unhook tethers from standoffs. Place display to one side.

f. Lift the logic board and pull forward. The rear of the logic board will unhook from the standoff pins. Lift and remove the board from the control box.

g. Take the new logic board from the anti-static bag and install in the control box, following steps b. to f. in reverse order.

NOTE

Logic board is secured at rear with (3) control box standoff pins. Logic board **MUST** interlock with standoffs.

Make sure the tether cords are secured properly with the front (2) logic board mounting screws.

Use caution when installing control box cover. Do not get tethers or harness pinched behind the gasket.

h. Place the removed logic board back into the anti--static bag and part box for return.

i. Reconnect negative battery cable and check microprocessor configurations.

NOTE BEFORE STARTING THE UNIT

When replacing a microprocessor it is important to check that the configurations are compatible with the unit into which it will be installed.

6.32.2 To Remove and Replace Microprocessor Logic Board - Tall Box:

⚠ CAUTION

Do not drill out the logic board standoffs to remove the plastic cover. Permanent damage to the microprocessor will result.

a. Before removing the microprocessor, turn the SROS to the "OFF" position and disconnect the negative battery cable. Attach a grounded wrist strap (CTD P/N 07-00304-00) to your wrist and ground it to a good unit frame ground.

b. Open the roadside side door of the unit and loosen the (2) bolts holding the cover / display assembly onto the front of the control box. Lift cover and use prop rod to hold cover up..

c. Unplug the (2) ribbon cables from the micro but leave them connected to the relay board and display.

d. Loosen the (5) hex head screws securing the logic board.

e. Push logic board down. The top of the logic board will unhook from the standoff pins. Remove the board from the control box.

f. Take the new logic board from the anti-static bag and install in the control box, following steps b. to f. in reverse order.

NOTE

Logic board is secured at top with (3) control box standoff pins. Logic board **MUST** interlock with standoffs.

Use caution when lowering control box cover. Do not get harness pinched behind the gasket.

g. Place the removed logic board back into the anti-static bag and part box for return.

h. Reconnect negative battery cable and check microprocessor configurations.

NOTE BEFORE STARTING THE UNIT

When replacing a microprocessor it is important to check that the configurations are compatible with the unit into which it will be installed.

6.32.3 To Reach The Configuration Fields From The Keypad:

a. Place the SROS in the "OFF" position.

b. With the unit off, locate the serial port plug behind the control panel. Remove the protective cap to gain access to the wire terminals. Place an ***insulated jumper wire*** between wires SPA and SPB at the serial port plug.

⚠ CAUTION

Do not allow the insulated jumper wire be used to configure unit to touch any ground.

c. Place the SROS switch in the "RUN" position. The FAULT light will come on, and the micro display will read "CNF1 TV" or "CNF1 DI". ***Remove the jumper wire from the serial port and reinstall the protective cap***. The configuration screen will now remain available for five minutes. Scroll through the configuration list using the "FUNCTION" key and compare the settings with those shown in Table 6-1. If any of the configurations need to be changed, continue with the following steps.

d. To change the configuration selection:

1) Bring the configuration to be changed onto the display. Press the "ENTER" key to allow change access to the displayed configuration.

2) Press either the "UP" or "DOWN" keys to display available selections for that configuration. Leave the correct selection on the screen. The selection display will flash, warning the operator that the displayed value has not been entered. Press the "ENTER" key to enter the new selection into memory. (The display will revert to the original selection if no further action is taken for the next five seconds.)

3) Continue to scroll through the configuration list by pressing the "FUNCTION" key. Change any other configurations as required.

e. When finished, place the SROS in the "OFF" position, then back to the "RUN" position to start the unit.

6.32.4 Hour Meters

Using ReeferManager, the hour meters can be set to any value via the serial port, if the meters have less then 5 hours on them. This allows a replacement microprocessor to be set to the same hours as the microprocessor it is replacing.

The microprocessor has 2 programmable maintenance hourmeters which are set via the serial port. These maintenance hourmeters are compared to one of the hour meters (diesel, standby, or switch on). If the hour meter is greater than the maintenance hourmeter then the proper service alarm is triggered.

Table 6-1 Configuration Table

CONFIGURATION		DESCRIPTION	
CNF1 Note 1	OFF (DI)	Long glow cycle (Std Emission DI Engines)	
	ON (TV)	Short glow cycle (LE DI Engines, TV Engines)	
CNF2	OFF	CDT not used	
	ON	CDT used	
CNF3 Note 3	**OFF**	Max Set Point +86°F (All functions locked)	
	ON	Max Set Point +90°F (Modified function lock)	
CNF4	**OFF**	All trailer units must be OFF	
	ON		
CNF5	OFF		
	ON	All R-22 and R-404A trailer units	
CNF6	**OFF**	Trailer unit	
	ON		
CNF7	**OFF**	Normal speed warm-up	Rev. 3.25 and higher only
	ON	Low speed only engine warm-up	
CNF8	**OFF**	All trailer units	
	ON		
CNF9 Note 2	**OFF**	Out-of-range alarm only	
	ON	Out-of-range alarm and unit shut down	
CNF10	**OFF**	***All units OFF!***	
	ON	***Do Not Turn On***	
CNF11 Note 3	**OFF**	Functions changes normal	
	ON	Functions & Start Stop locked	
CNF12	OFF	R-22	
	ON	R-404A	
CNF13	**OFF**	Refrigeration unit (Trailer or Truck)	
	ON	Heat only unit (Solara)	
CNF14	**OFF**	Standard unit	
	ON	Reversible Multi-Temp	
CNF15	OFF	UltraFresh 1	
	ON	UltraFresh 2	
CNF16	**OFF**	Alt Aux alarm only	
	ON	Alt Aux alarm shuts unit down	
CNF17	OFF	UltraFreeze disabled	
	ON	UltraFreeze control on.	
CNF18	OFF	SYSTEM CK alarm Off	
	ON	SYSTEM CK alarm On	
CNF19	OFF	OFF on all units except XT and X2 models.	
	ON	XT and X2 units (Rev U3 3.23 & higher)	
CNF20 Note 4	**OFF**	°F / °C Unlocked	
	ON	°F / °C Locked	

NOTES

***** These settings are optional and can be set to customer specifications or left at default values. All other settings (not marked with *****) **MUST** be set as shown for proper unit operation.

1. **CNF1** determines the length of the glow cycle, which varies depending on the type of engine in the unit. When CNF 25 is ON, the CNF1 setting is not used.

2. **CNF9** allows selection of how the unit will react under an Out-Of-Range condition. An Out-Of-Range condition is described as the box temperature having arrived at setpoint, then drifting away from setpoint. With this CNF in the OFF position, once the box temperature has been Out-Of-Range for 15 minutes, the ALARM light will be turned on and the alarm display "OUT RANGE" will be displayed alternately with the default display of the setpoint and box temperature. With this CNF in the ON position, once the box temperature has been Out_Of_Range for 45 minutes, the unit will shut down, and the same alarms as described above will be displayed.

3. **CNF3 & CNF11**
   Standard Function Lock allows the Function Key and the Start/Stop-Continuous Run Key to be locked so that no changes can be made.

   Modified Function Lock is the same as Standard Function Lock except that with the setpoint at or between +32 and +42°F (0 and 5.6°C), the unit will always operate in Continuous Run. If the setpoint is outside this range, either Start/Stop or Continuous Run can be selected.
   The maximum setpoint and function lock are controlled via a combination of CNF3 and CNF11:

   CNF11 OFF / CNF3 OFF: Maximum set point 86°F (30°C) - No function lock

   CNF11 ON / CNF3 OFF: Maximum set point 86°F (30°C) - Standard function lock

   CNF11 OFF / CNF3 ON: Maximum set point 90°F (32.2°C) - No function lock

   CNF11 ON / CNF3 ON: Maximum set point 90°F (32.2°C) - Modified function lock

4. **CNF20** allows the Fahrenheit / Celsius function to be locked. In order to change the units setting, CNF20 must be OFF. The units setting can then be changed in the functional parameters list. If CNF20 is ON the units setting cannot be changed from the functional parameters list.

Table 6-1. Configuration Codes (Continued)				
CONFIGU-RATION		**DESCRIPTION**		
CNF21	**OFF**	Normal Multi-Temp Logic	Rev. 3.23 and higher only	
	ON	Multi-Temp Frozen Priority Logic		
CNF22	**OFF**	For future use. Do not turn on.		
CNF23	OFF	Set Point not Locked	Rev. 3.29 and higher only	
	OFF	Set Point Locked		
CNF24	**OFF**	All trailer units are OFF		
	ON	Truck units only		
CNF25	**OFF**	All Engines with glow plugs.	Rev. 3.31 and higher only	
	ON	Tier 4i Engine with air heater.		
CNF26	**OFF**	For future use. Do not turn on.		
CNF27	**OFF**	For future use. Do not turn on.		
CNF28	**OFF**	For future use. Do not turn on.		
CNF29	**OFF**	For future use. Do not turn on.		
CNF30	**OFF**	For future use. Do not turn on.		
CNF31	**OFF**	For future use. Do not turn on.		
CNF32	**OFF**	For future use. Do not turn on.		

6.33 SENSOR CHECKOUT

An accurate ohmmeter must be used to check resistance values shown in Table 6-2.

Due to variations and inaccuracies in ohmmeters, thermometers or other test equipment, a reading within 2% of the chart value would indicate a good sensor. If a sensor is bad, the resistance reading will usually be much higher or lower than the resistance values given in Table 6-2.

At least one lead from the sensor (RAS, terminals D1 and E1 or SAS, terminals D2 and E2) must be disconnected from the unit electrical system before any reading is taken. Not doing so will result in a false reading. Two preferred methods of determining the actual test temperature at the sensor, is an ice bath at 32°F (0°C) or a calibrated temperature tester.

Table 6-2. Sensor Resistance (ATS, CDT, RAS, SAS, & WTS)

Temperature		ATS, RAS, SAS & WTS Resistance In Ohms	CDT Resistance In Ohms
°F	°C		
-20	-28.9	165,300	1,653,000
-10	-23.3	117,800	1,178,000
0	-17.8	85,500	855,000
10	-12.2	62,400	624,000
20	- 6.7	46,300	463,000
30	- 1.1	34,500	345,000
32	0	32,700	327,000
40	4.4	26,200	262,000
50	10.0	19,900	199,000
60	15.6	15,300	153,000
70	21.1	11,900	119,000
77	25	10,000	100,000
80	26.7	9,300	93,000
90	32.2	7,300	73,000
100	37.8	5,800	58,000
110	43.3	4,700	47,000
120	48.9	3,800	38,000
194	90	915	9,150
212	100	680	6,800
266	130	301	3,010
302	150	186	1,860

6.34 SUCTION PRESSURE TRANSDUCER

Before installing a new suction pressure transducer it must be calibrated.

The calibration will not be performed if the run relay is energized. This prevents the operator from calibrating the unit with the sensor in the system. The reading of the sensor must be at atmospheric pressure (0 psig/Bari). If the sensor reading is greater than 20 psig (1.36 Bar) or less than -13.6inHg it can not be calibrated. Once the micro is calibrated, the display will readout the actual value.

1. Turn power off and remove starter solenoid wire, then turn unit back on and let unit fail to start. This will de--energize run relay.
2. Connect wiring to new suction pressure transducer. Before installing suction pressure transducer into compressor, display the suction pressure via the unit status display. While the suction pressure is being displayed press ENTER key for 3 seconds, the display should read "0". If display reads "0" install suction pressure transducer into compressor.

NOTE

If display doesn't indicate zero, check suction pressure transducer and micro wiring.

2. Install new suction pressure transducer and reconnect starter wire.

6.35 UNIDRIVE TORQUE REQUIREMENTS (See Figure 6-35)

Extensive damage may occur if the proper hardware and procedures are not followed. Periodic inspection of hardware and bolt torque is recommended to insure the integrity of the unidrive.

NOTE

Thread locking sealant, 3/8 flat washer and 3/8 lock washer *must* be used on bolts between the compressor mounting flange and the engine bellhousing. The recommended sealant is Loctite screw lock no. 262.

The following figures show the torque value, size and grade of the hardware to be used when reassembling the unidrive assembly.

6.35.1 Drive Gear (See Figure 6-20)

When installing a nylon drive gear always:

1. Install with black dot facing steel gear attached to compressor.
2. Use new bolts and locking tabs included in drive gear kit.
3. Use Locktite or a similar thread locking compound on threads of drive gear bolts.
4. DO NOT use never-seize or any other lubricating compound on the nylon drive gear or compressor steel gear. The gear must be assembled dry.
5. Torque the (6 bolt) nylon drive gear bolts to 30 ft-lbs. (41 Nm).

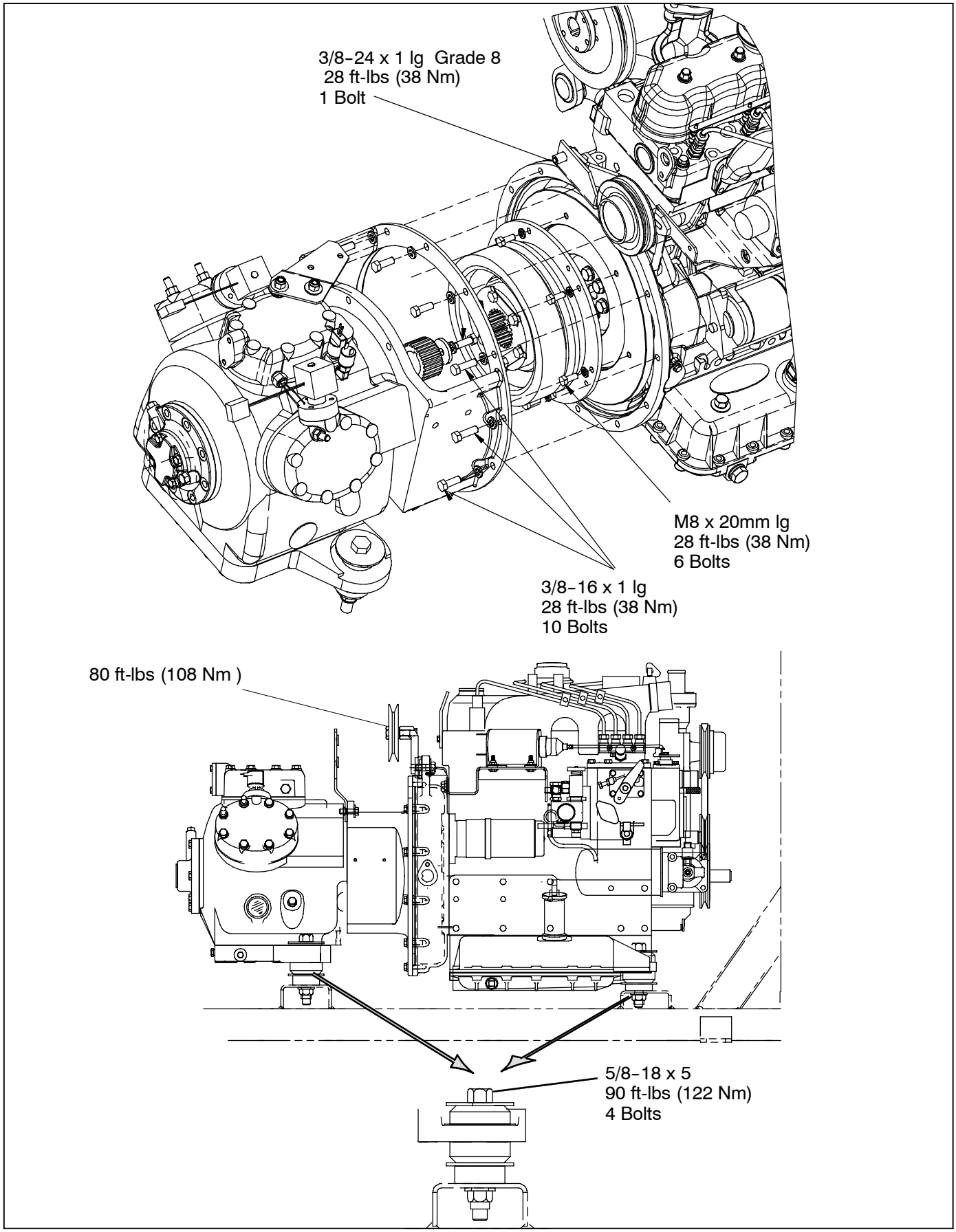


Figure 6-35. Unidrive Torque Requirements – Non ESC Engine

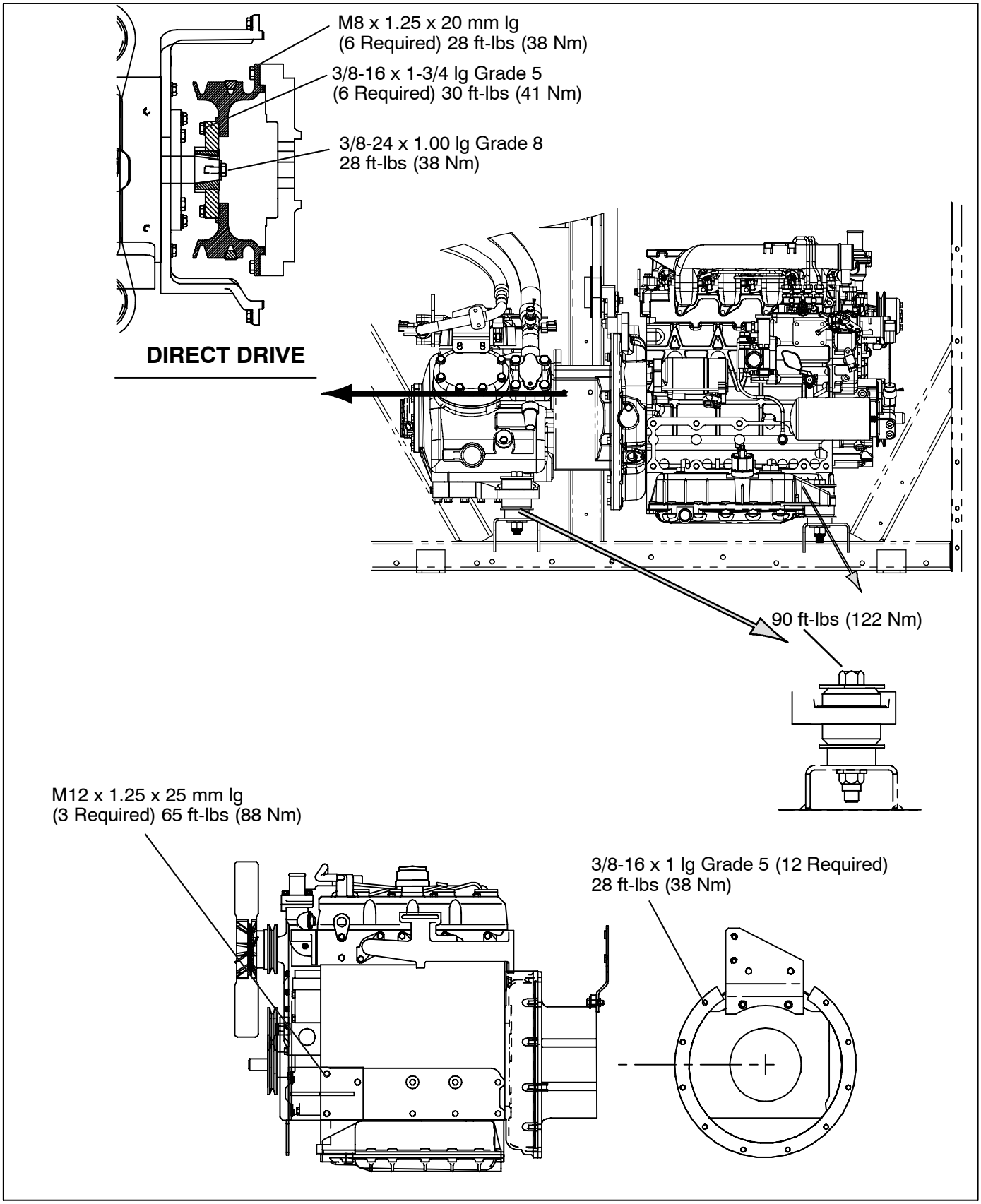

M8 x 1.25 x 20 mm lg
(6 Required) 28 ft-lbs (38 Nm)
3/8-16 x 1-3/4 lg Grade 5
(6 Required) 30 ft-lbs (41 Nm)
3/8-24 x 1.00 lg Grade 8
28 ft-lbs (38 Nm)
DIRECT DRIVE
90 ft-lbs (122 Nm)
M12 x 1.25 x 25 mm lg
(3 Required) 65 ft-lbs (88 Nm)
3/8-16 x 1 lg Grade 5 (12 Required)
28 ft-lbs (38 Nm)

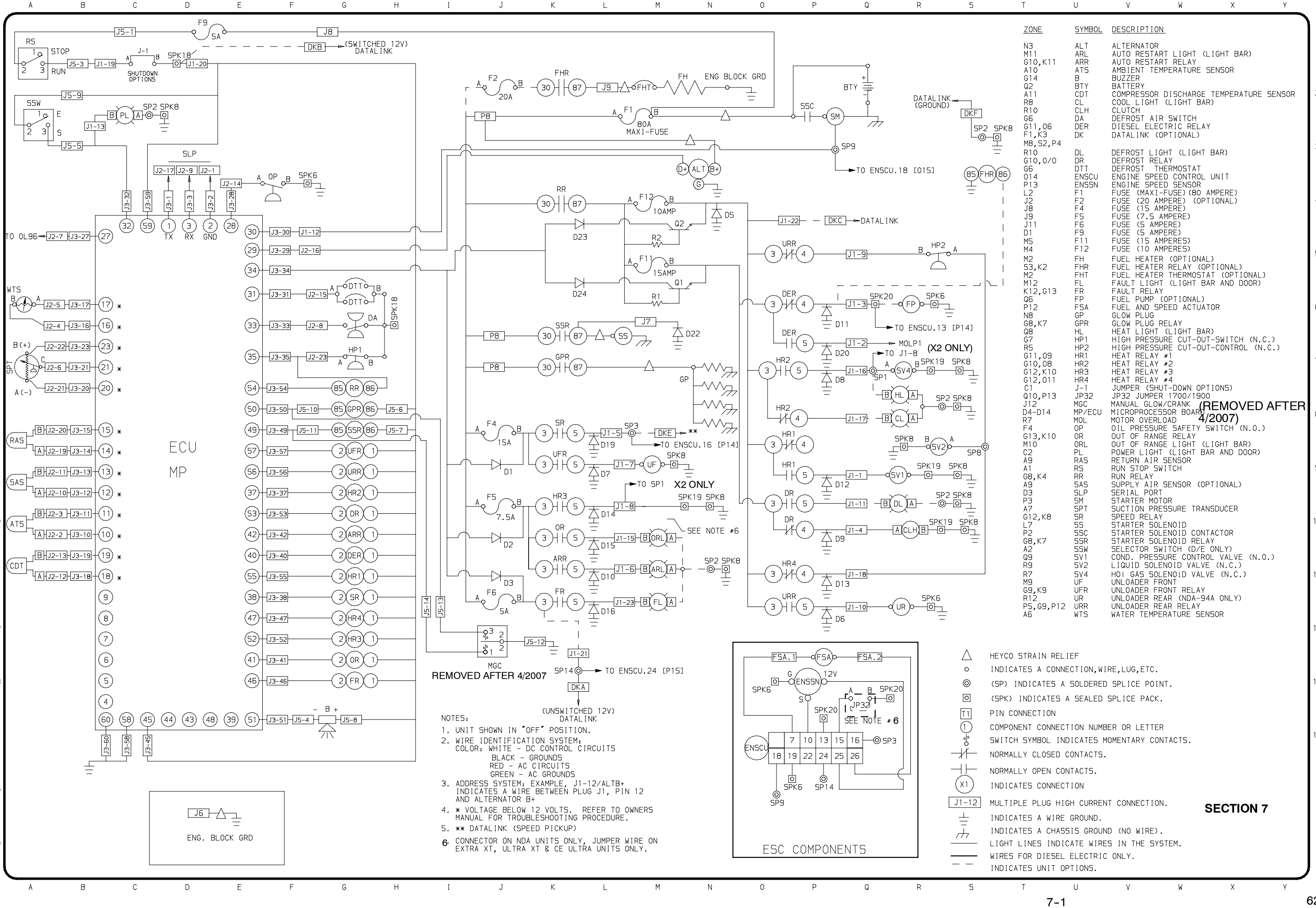
Figure 6-36. Unidrive Torque Requirements – Electronic Speed Control Engine

Table 6-3. R-404A Temperature–Pressure Chart

Temperature		Pressure			Temperature		Pressure		
°F	°C	Psig	Kg/cm2	Bar	°F	°C	Psig	Kg/cm2	Bar
–40	–40	4.5	0.32	0.31	32	0	72.5	5.10	5.00
–35	–37	7.1	0.50	0.49	34	1	75.6	5.32	5.21
–30	–34	9.9	0.70	0.68	36	2	78.8	5.54	5.43
–25	–32	12.9	0.91	0.89	38	3	82.1	5.77	5.66
–20	–29	16.3	1.15	1.12	40	4	85.5	6.01	5.90
–18	–28	17.7	1.24	1.22	42	6	89.0	6.26	6.14
–16	–27	19.2	1.35	1.32	44	7	92.5	6.50	6.38
–14	–26	20.7	1.46	1.43	46	8	96.2	6.76	6.63
–12	–24	22.3	1.57	1.54	48	9	99.9	7.02	6.89
–10	–23	23.9	1.68	1.65	50	10	103.7	7.29	7.15
–8	–22	25.6	1.80	1.77	55	13	115.4	8.11	7.96
–6	–21	27.3	1.92	1.88	60	16	126.1	8.87	8.69
–4	–20	29.1	2.05	2.01	65	18	137.4	9.66	9.47
–2	–19	30.9	2.17	2.13	70	21	149.4	10.50	10.30
0	–18	32.8	2.31	2.26	75	24	162.1	11.40	11.18
2	–17	34.8	2.45	2.40	80	27	175.5	12.34	12.10
4	–16	36.8	2.59	2.54	85	29	189.6	13.33	13.07
6	–14	38.9	2.73	2.68	90	32	204.5	14.38	14.10
8	–13	41.1	2.89	2.83	95	35	220.2	15.48	15.18
10	–12	43.3	3.04	2.99	100	38	236.8	16.65	16.33
12	–11	45.6	3.21	3.14	105	41	254.2	17.87	17.53
14	–10	48.0	3.37	3.31	110	43	272.4	19.15	18.78
16	–9	50.4	3.54	3.47	115	46	291.6	20.50	20.11
18	–8	52.9	3.72	3.65	120	49	311.8	21.92	21.50
20	–7	55.5	3.90	3.83	125	52	332.9	23.41	22.95
22	–6	58.1	4.08	4.01	130	54	355.0	24.96	24.48
24	–4	60.9	4.28	4.20	135	57	378.1	26.58	26.07
26	–3	63.7	4.48	4.39	140	60	402.3	28.28	27.74
28	–2	66.5	4.68	4.59	145	63	427.6	30.06	29.48
30	–1	69.5	4.89	4.79	150	66	454.0	31.92	31.30

Table 6-3. R-404A Temperature–Pressure Chart

Temperature		Pressure			Temperature		Pressure		
°F	°C	Psig	Kg/cm2	Bar	°F	°C	Psig	Kg/cm2	Bar
–40	–40	4.5	0.32	0.31	32	0	72.5	5.10	5.00
–35	–37	7.1	0.50	0.49	34	1	75.6	5.32	5.21
–30	–34	9.9	0.70	0.68	36	2	78.8	5.54	5.43
–25	–32	12.9	0.91	0.89	38	3	82.1	5.77	5.66
–20	–29	16.3	1.15	1.12	40	4	85.5	6.01	5.90
–18	–28	17.7	1.24	1.22	42	6	89.0	6.26	6.14
–16	–27	19.2	1.35	1.32	44	7	92.5	6.50	6.38
–14	–26	20.7	1.46	1.43	46	8	96.2	6.76	6.63
–12	–24	22.3	1.57	1.54	48	9	99.9	7.02	6.89
–10	–23	23.9	1.68	1.65	50	10	103.7	7.29	7.15
–8	–22	25.6	1.80	1.77	55	13	115.4	8.11	7.96
–6	–21	27.3	1.92	1.88	60	16	126.1	8.87	8.69
–4	–20	29.1	2.05	2.01	65	18	137.4	9.66	9.47
–2	–19	30.9	2.17	2.13	70	21	149.4	10.50	10.30
0	–18	32.8	2.31	2.26	75	24	162.1	11.40	11.18
2	–17	34.8	2.45	2.40	80	27	175.5	12.34	12.10
4	–16	36.8	2.59	2.54	85	29	189.6	13.33	13.07
6	–14	38.9	2.73	2.68	90	32	204.5	14.38	14.10
8	–13	41.1	2.89	2.83	95	35	220.2	15.48	15.18
10	–12	43.3	3.04	2.99	100	38	236.8	16.65	16.33
12	–11	45.6	3.21	3.14	105	41	254.2	17.87	17.53
14	–10	48.0	3.37	3.31	110	43	272.4	19.15	18.78
16	–9	50.4	3.54	3.47	115	46	291.6	20.50	20.11
18	–8	52.9	3.72	3.65	120	49	311.8	21.92	21.50
20	–7	55.5	3.90	3.83	125	52	332.9	23.41	22.95
22	–6	58.1	4.08	4.01	130	54	355.0	24.96	24.48
24	–4	60.9	4.28	4.20	135	57	378.1	26.58	26.07
26	–3	63.7	4.48	4.39	140	60	402.3	28.28	27.74
28	–2	66.5	4.68	4.59	145	63	427.6	30.06	29.48
30	–1	69.5	4.89	4.79	150	66	454.0	31.92	31.30



ZONE	SYMBOL	DESCRIPTION
N3	ALT	ALTERNATOR
M11	ARL	AUTO RESTART LIGHT (LIGHT BAR)
G10,K11	ARR	AUTO RESTART RELAY
A10	ATS	AMBIENT TEMPERATURE SENSOR
G14	B	BUZZER
Q2	BTY	BATTERY
A11	CDT	COMPRESSOR DISCHARGE TEMPERATURE SENSOR
R8	CL	COOL LIGHT (LIGHT BAR)
R10	CLH	CLUTCH
G6	DA	DEFROST AIR SWITCH
G11,06	DER	DIESEL ELECTRIC RELAY
F1,K3	DK	DATALINK (OPTIONAL)
M8,S2,P4		
R10	DL	DEFROST LIGHT (LIGHT BAR)
G10,0/0	DR	DEFROST RELAY
G6	DTT	DEFROST THERMOSTAT
O14	ENSCU	ENGINE SPEED CONTROL UNIT
P13	ENSSN	ENGINE SPEED SENSOR
L2	F1	FUSE (MAXI-FUSE)(80 AMPERE)
J2	F2	FUSE (20 AMPERE) (OPTIONAL)
J8	F4	FUSE (15 AMPERE)
J9	F5	FUSE (7.5 AMPERE)
J11	F6	FUSE (5 AMPERE)
D1	F9	FUSE (5 AMPERE)
M5	F11	FUSE (15 AMPERES)
M4	F12	FUSE (10 AMPERES)
M2	FH	FUEL HEATER (OPTIONAL)
S3,K2	FHR	FUEL HEATER RELAY (OPTIONAL)
M2	FHT	FUEL HEATER THERMOSTAT (OPTIONAL)
M12	FL	FAULT LIGHT (LIGHT BAR AND DOOR)
K12,G13	FR	FAULT RELAY
Q6	FP	FUEL PUMP (OPTIONAL)
P12	FSA	FUEL AND SPEED ACTUATOR
N8	GP	GLOW PLUG
G8,K7	GPR	GLOW PLUG RELAY
Q8	HL	HEAT LIGHT (LIGHT BAR)
G7	HP1	HIGH PRESSURE CUT-OUT-SWITCH (N.C.)
R5	HP2	HIGH PRESSURE CUT-OUT-CONTROL (N.C.)
G11,09	HR1	HEAT RELAY #1
G10,08	HR2	HEAT RELAY #2
G12,K10	HR3	HEAT RELAY #3
G12,011	HR4	HEAT RELAY #4
C1	J-1	JUMPER (SHUT-DOWN OPTIONS)
Q10,P13	JP32	JP32 JUMPER 1700/1900
J12	MGC	MANUAL GLOW/CRANK (REMOVED AFTER 4/2007)
D4-D14	MP/ECU	MICROPROCESSOR BOARD
R7	MOL	MOTOR OVERLOAD
F4	OP	OIL PRESSURE SAFETY SWITCH (N.O.)
G13,K10	OR	OUT OF RANGE RELAY
M10	ORL	OUT OF RANGE LIGHT (LIGHT BAR)
C2	PL	POWER LIGHT (LIGHT BAR AND DOOR)
A9	RAS	RETURN AIR SENSOR
A1	RS	RUN STOP SWITCH
G8,K4	RR	RUN RELAY
A9	SAS	SUPPLY AIR SENSOR (OPTIONAL)
D3	SLP	SERIAL PORT
P3	SM	STARTER MOTOR
A7	SPT	SUCTION PRESSURE TRANSDUCER
G12,K8	SR	SPEED RELAY
L7	SS	STARTER SOLENOID
P2	SSC	STARTER SOLENOID CONTACTOR
G8,K7	SSR	STARTER SOLENOID RELAY
A2	SSW	SELECTOR SWITCH (D/E ONLY)
Q9	SV1	COND. PRESSURE CONTROL VALVE (N.O.)
R9	SV2	LIQUID SOLENOID VALVE (N.C.)
R7	SV4	HOI GAS SOLENOID VALVE (N.C.)
M9	UF	UNLOADER FRONT
G9,K9	UFR	UNLOADER FRONT RELAY
R12	UR	UNLOADER REAR (NDA-94A ONLY)
P5,G9,P12	URR	UNLOADER REAR RELAY
A6	WTS	WATER TEMPERATURE SENSOR

- HEYCO STRAIN RELIEF
- INDICATES A CONNECTION,WIRE,LUG,ETC.
- (SP) INDICATES A SOLDERED SPLICE POINT.
- (SPK) INDICATES A SEALED SPLICE PACK.
- T1 PIN CONNECTION
- (1) COMPONENT CONNECTION NUMBER OR LETTER
- SWITCH SYMBOL INDICATES MOMENTARY CONTACTS.
- NORMALLY CLOSED CONTACTS.
- NORMALLY OPEN CONTACTS.
- (X1) INDICATES CONNECTION
- J1-12 MULTIPLE PLUG HIGH CURRENT CONNECTION.
- INDICATES A WIRE GROUND.
- INDICATES A CHASSIS GROUND (NO WIRE).
- LIGHT LINES INDICATE WIRES IN THE SYSTEM.
- WIRES FOR DIESEL ELECTRIC ONLY.
- — INDICATES UNIT OPTIONS.

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